PROCEEDINGS OF THE

Thirty-first Annual Convention

OF THE

American Railway Bridge and Building Association

HELD AT

NEW YORK CITY

October 18-20, 1921

REPORTS IN THIS ISSUE

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Recruiting of Bridge and Building Employes
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C R Knowles

President, 1922

PROCEEDINGS OF THE

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OF THE

American Railway Bridge and Building Association

Successor to the

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS

HELD AT

NEW YORK CITY

OCTOBER 18-20, 1921

Official Badge

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PROCEEDINGS

The thirty-first annual convention of the American Railway Bridge and Building Association convened in the ball room of the Hotel McAlpin, New York City, on Tuesday, Oct. 18, 1921, President W. F. Strouse presiding.

Meeting called to order at 10 a. m.

President Strouse:—We will now listen to the invocation by our secretary.

Invocation by Secretary Lichty.

President Strouse:—We have with us this morning Francis P. Bent, a member of the board of estimates and awards of the city of New York, who will welcome this convention to New York. I take pleasure in introducing Mr. Bent.

Mr. Bent:—Mr. Chairman, members of the American Railway Bridge and Building Association, ladies and gentlemen:—Mayor Hylan has asked me to come here and represent him at this time. He wants me to express his regrets that he cannot be here personally and speak to you. He also wants me to thank the committee for the kind invitation that was extended, and also to wish you all a very pleasant and profitable visit in our city.

The mayor of the great metropolis of America has asked me to welcome you here at this convention. New York is becoming more of a convention city than it has been in the past. You can come here and find many diversions and I am sure, from the itinerary that has been planned, that the next three days may prove most enjoyable.

We are all proud of New York City. This feeling is not confined to those who live here, but is shared by those who reside elsewhere because there is no city in the world today that can compare with New York. It would take you more than three days to see the many things that we have here to show you, and of which we may be justly proud. The ladies will have a drive around our

streets and parks. Riverside Drive, with the beauty of the Hudson, probably cannot be equalled by any other drive in the world. Our museums, our churches, our many institutions all bid you welcome and I trust you will be able to see many of them.

You men are builders, and you will be interested to know that we have a very large school building program here. This program calls for an outlay of 75 million dollars for schools, and additions to schools. Because of the war, our building program was delayed and it was impossible for this present administration to do any building of that kind during the first two years of its term, much as schools were needed. We are now trying to catch up with it and as you see, it requires a large amount of money. We have completed and opened on the first of the school year in September 12 new schools, very large ones. We shall have 9 more ready to open before the first of January. We have 12 more under contract and a number of sites have been secured in addition to that. I cite that only as one illustration of the way things are done in New York, and the large amount of money that is required for such a program.

We have, I believe, the very best police department that can be found in any large city and the fire protection is unequalled. We have the purest water. The bringing of this water to our city was one of our largest undertakings. Although you know that prices have advanced everywhere for most everything, the city didn't advance the charges for water because that system was built, operated and owned by the city. We feel that if some of the other public utilities were owned and operated by the city, there would be no reason for any advance in cost to the people.

I don't want to burden you with a long description of the statistics of New York. Let me say, however, that when it comes to health, we lead the world. Only two weeks ago, the records of the health department showed that we had the lowest death rate in the history of our city, or in the history of any large city where there is such congestion as you find here in spots. That is due to our splendid health department, to our tenement house law, and to many other measures which tend to improve the healthful conditions of our city. (Applause.)

President Strouse:—I feel that I express the sentiments of the Association in thanking Mr. Bent for his address.

We now have another speaker, W. G. Besler, president and

general manager of the Central Railroad of New Jersey, who will talk to us at this time.

W. G. Besler:—I am coming up to the platform so that I may have the pleasure of seeing before me those faces that bring me back to the time when I had that close association which resulted in that alacrity with which I accepted the invitation to be with you this morning. Mr. Bent has extended to you a royal welcome, and on behalf of the railroads operating in and about the city, I extend to you also that welcome which is your due and which I wish you to understand comes from the heart.

This Association was formed in 1891 and that brings me back to the period when I am young again. I was with you, if not in person at that meeting, in proxy through our supervisor of bridges and buildings. I was superintendent of the old St. Louis division of the Burlington, running from Rock Island, Sterling and Savanna to St. Louis. In looking into the faces here this morning, I am impressed with the thought that I am among my kind. I am among the breed with whom I am proud to be because of my early days.

I am sitting on the front end of a hand car, on a box; beside me is the supervisor of bridges and buildings, and the foreman of one of the divisions. We are stopping at various bridges, examining them and making notes. We are making one of the semi-annual examinations, and we are going 247 miles. The bridge and building car has been sent on ahead. We stop at some intermediate point, and go on next day. How many of you men are with me on that trip? Do you recognize it?

You will also recognize another feature I will point out. We are at a wash-out. The end of the trestle has gone down. It is swinging. Our men are there, the lumber is coming, and they are repairing it. Or we are at a burn-out and the same thing is taking place. It is a big job (the trains are being detoured, perhaps absolutely stopped) to get that train across and that traffic moving across those structures. So when I say I am with you I am with you at those things which are events. The ordinary routine of work was ordinary everyday work. Those things are the events I look back upon and with the pleasure and pride I had in accomplishments when we had overcome some particularly bad wash-out or burn-out. So I say in the beginning that when I was invited to come to this meeting today I came because I wanted to be here and wanted to look into the faces of you men who are here, the kind that I know and love.

I might reminisce; because of the moment and some of the things which are confronting us I will, perhaps. My first experience with a big strike was the Martin Iron strike in St. Louis. Do you remember the shooting at the Green Tree Inn, the massacre as it was called? I was there as a young man and saw it. In that strike, the company had as its deputies 68 men as I remember, composed of bridge and building gangs, and a finer set of men was never brought together. Those were the days when there was trouble; the emergency men that responded to that trouble were the bridge and building gangs and men of that caliber and character, real men. Somebody said recently, (one of the train men, by the way,) "Those were the days when we had wooden cars and iron men; now we have iron cars and wooden men." (Applause.)

We are now passing through a most momentous crisis, and I believe that it is a matter for every man to bring right home to himself because, after all, when we think about somebody else we are perfectly willing that he should do this, that or the other thing—it doesn't affect us; but when it comes home to us, we ask: "How is this going to affect me? What is my interest in this affair?"

We all understand that. If we do, we think about what we are to do under the circumstances. You know that we are confronted with a threatened railroad strike, that the train organizations have threatened to tie up the entire country in a general strike. I don't believe such a strike is going to take place, but we have been told in language as positive as can be made that it will take place. We would be blind to our duties, if we did not take that necessary action which comes in a situation of that kind, and I can tell you that action is being taken and will be taken because it is our duty as men to meet those duties and responsibilities if we are loyal employes.

When the strike vote was taken, it was not a vote to strike. It was in the form of a question, "Do you want your wages cut?" That is about the substance of it. If we sent to this audience this morning a ballot saying, "Do you want to have your wages reduced? Answer yes or no," every one would write no. That is the sort of ballot that was sent out. But if you should be asked, "Do you intend to leave your position because the companies cannot pay the going rate of wage that is being paid to this organization, and under those circumstances will you consent to give up that proportion of your wage with the distinct understanding and pur-

pose that that high cost of living with which we have all become acquainted and have suffered under will be reduced correspondingly?"

I say with all positive assurance that the high cost of living cannot be reduced so long as there goes into the high cost of living the high cost of production. If a man today can only buy 50 or 62 cents' worth of goods with a dollar bill, he is no worse off if he has only 62 cents, but is able to buy 62 cents' worth of goods. In fact, he has as much pleasure and comfort, just as much luxury as if he had twice the amount of money with half its purchasing power. Yet human nature is the same. You and I and any one else, with a handful of money, has at least the satisfaction of spending that additional amount. It goes without saying that there would not be that absolute certainty of expression which we find from those who are capable and competent to deal with the matter, who tell us and explain to us and give us by chart, diagram and statistics just what will happen under the new conditions which are proposed. Nevertheless and in view of this situation and as explained to the men who have taken this strike vote, we are told that there will be a strike. Well, if it comes, it will come, but nothing can happen to any body of men which those men do not design or will shall not happen if they set their faces against it. If those self-same men who vote for a strike, vote against a strike, of course, there would be no strike. There are things which we cannot control such as disease, something of that kind may attack us unawares, and we combat that as best we can, but the question that every man in this room, and every place else is asking himself is, "What is going to happen to me, my family and my personal fortunes?"

My answer is, "Nothing is going to happen that you don't want to happen. It lies in your hands to not have those things happen. If you believe that certain things should come to pass by proper strength of movement, because right and justice is on your side, if it be, it will come to pass. If you elect that things shall not come to pass, then by similar movement, particularly if it originates with such men as we have here, a firm and pronounced expression of 'Thou shalt not' also has its effect and brings the answer."

I don't believe that this organization is a striking organization. I feel that you are in the category of an audience which I addressed on the fourth of this month, our Veterans' Association, a body of men who came together voluntarily with a pride of serv-

ice and formed themselves into a body of veterans, for mutual good. These men come together once a year by invitation of the company for an annual reunion, and we have asked the men to bring their wives and their families with them because we believe it is a good thing for men who have had long and faithful and loyal service with a company, to meet other men like situated and with similar records to their credit.

I said to those men just as I have said to you that I apprehend that this is not a striking organization. I said, "Of course, you know that I am not going to strike. I will be here tomorrow in case there is a strike just the same as I was yesterday, last week or last year, and I will be here next week and next year, if the Lord is willing. Therefore, if you see fit, at your time of life, to leave your places and give them up to someone else who, under present conditions, will be an aspirant therefor, certainly it is a matter of your individual choice, but I can't imagine how a man above middle age who has a family and has established himself, can be so foolish as to think of such a thing under all conditions, because between himself and the company there exists a bond, a family bond, if you please. He is a member of that family. He has established himself for years; he has received that compensation which he has earned and faithfully earned, but it has come regularly every two weeks or every month and he has adjusted his affairs to meet that condition and situation."

Now, what can happen to his benefit in leaving a situation, disrupting that condition and trying something different? Of course, the organization can call him out, but it can't call him back. They haven't a check at the end of every two weeks to hand him in return for what he may be doing for them, nor can they guarantee that he can come back to his place, particularly if events do not go to the liking or the thoughts of leaders who called him out but can't call him back.

I am going into this matter at length because it is a matter of immediate importance and will affect many of you who are in this room. Some of you have sons, or younger relatives, who have not had the experience you have had, who have not lived through the Martin Iron and other strikes that we know all about. To those men it is a new experience, and they are quite willing to try anything once. Men who have been through and know both sides of the question know what to expect. As I said, it has been my experience to have been in every large strike since Martin Iron, and

more often than not over the top. I can answer any question that any man asks me concerning a railroad strike, a mine strike or a manufacturing strike. I have the answer; I know the thing from beginning to end; I know all that is to be known of a situation of that kind.

So, it is for such men as you, who have prestige, and power over the younger men to say, "Well, boys, you think this is all right, but the old man is not going out. He is going to be right there to-morrow and next week where he has been all these years. That is his place; that is right, and he is doing the right and loyal thing. I advise you, don't do it. This is not the time nor the place."

That is the least you can do, but that you can do. You will be in the position that arose at one time in one of the shops. Forty-four men in one of the shops went on strike. I called the men of that shop together on Sunday morning and 169 men responded. Most of them were men considerably advanced in years. I asked those men if they had said anything to the boys. (Most of them had sons in the service.) They said they had, but the young fellows were being carried away by the other side.

I said, "All you want is to be let alone. You don't want to be interfered with. You don't want to have to do those things from the outside that you do not concur in. Have you talked with the man on the next bench, and said, 'I don't intend to have any trouble'? If 20 or 30 of you men say, 'We do not intend to leave our places; we do not intend to go out upon this unauthorized movement,' you will find 40 or 60 other men will go with you because that is what they have in their hearts to do rather than do the other thing."

As the result of that, those men prevailed. Those men determined they wanted none of this trouble and the 44 men walked out, and as far as I know are walking to this day.

I am giving you that by way of illustration, and one further thought which I gave to our veterans. If you have a physician in whom you have a great deal of confidence, to whom you have been going for years for advice, and one day he says, "I have something here which I think will do you good."

"What is it?"

He says, "It is poison; I want you to take it."

You will say, "No, no."

"Yes, take it. Commit suicide. It is a good thing for you I think."

You say, " No, no. I think I will find another doctor. I am not ready to drink your poison or commit suicide."

That is a situation which finds its parallel, as I think you can see.

In conclusion, again reverting to the railroads, if there is, while you men and your families are here, anything that we of the railroads can do to make your visit more pleasant, more comfortable, let us know. These meetings are always profitable. I believe in them. I want this association to continue and to bring in additional members. Bring in, if you can, those younger men who are coming into the service and who, one day, in the natural course of events, will have to take our places. Let's have them with us while we are here to teach them the way, and give them the advice and teachings of these meetings. Bring your wives for these annual gatherings. It is certainly fine to see so many here, and I hope and expect you will continue to bring them indefinitely. (Applause.)

The next in order on our program is the address of the president.

PRESIDENT'S ADDRESS

On February 21, last, I addressed a circular letter to the officers and members of committees of this association, calling their attention to the fact that a great city had been selected in which to hold this convention, and that there were many things in New York well worth seeing. At the time that I wrote that letter, I had not heard the story of the Denver man who had occasion to make his initial visit to New York. He remained two weeks longer than was his original intention, and in writing to his wife of his experience said, " New York is a great city, but I do wish that I had come here before I was converted."

Whether our members, many of whom have traveled great distances to attend this convention, have been converted or not, I do not know, but since our Denver friend was able to find amusement for two weeks after his allotted time had expired, I feel that my statement has been fully vindicated. However, to make the matter doubly sure, I bespeak the hearty coöperation of all the ladies who have honored us with their presence on this occasion. Don't be too exacting as to your husband's movements. It has taken 30 years of persuasion, special solicitation and much oratory to bring this association to New York. After once having been here, I am con-

fident that much less time will be required to induce it to pay another visit. Our committee on arrangements has been so active in its duties, that I am sure that when this convention is ended, all will be convinced that it knew just what to do to make our stay pleasant.

The total membership at the close of our last convention, was 840, and our membership committee will propose a list of 65 applicants for membership at this meeting. Each year since its organization, our association has enjoyed a healthy growth, not only in numbers but in the character of work done. About 12 per cent of the membership served as officers and committeemen to carry on the work of the association this year. This does not include the individual members who have contributed indirectly toward the preparation of committee reports. While this represents a fair percentage, there is still room for greater activity on the part of the membership in general and the committeemen in particular.

In arranging the personnel of the various committees, I was governed very largely by the positions held. In addition, I purposely named large committees in the hope of cutting down the amount of work each man would normally be expected to do. Reports from some of the chairmen, however, indicate a decided indifference on the part of some of the committeemen as to the fate of the reports or the embarrassment of the chairmen. I regret the necessity of referring to this matter, but do so because I found it very difficult this year to secure men who were willing to head committees. The success of this association depends to a large degree upon the hearty coöperation of every member, and we should have it.

Since our last meeting, death has invaded our ranks, and called to their reward 10 of our members, who, with their families will be missed by their many friends, at these meetings. Robert C. Sattley, valuation engineer of the Chicago, Rock Island & Pacific, died at his home in Chicago on December 31, 1920. James Stannard, a life member of this association, formerly connected with the Wabash, died on January 7, 1921, at his home in Kansas City, Mo. J. M. Wilkinson, a former superintendent of bridges and buildings on the Cincinnati Northern, died after a lingering illness at his home in Van Wert, Ohio, on January 29, 1921. William A. Lydston, a former supervisor of the Boston and Maine, died in January, 1921. Major John D. Moen, formerly superintendent of bridges and buildings of the Chicago, St. Paul, Minneapolis and

Omaha, died on June 30, 1921, in Chicago. More recent deaths are those of Harry James, general foreman of bridges and buildings of the Colorado and Southern; C. E. Powell, general inspector of bridges of the Chesapeake and Ohio; William Ross of the Chicago, Milwaukee and St. Paul; C. W. Brown, of the Southern Pacific, and J. M. Staten, general bridge inspector of the Chesapeake and Ohio.

In casting a retrospect over the past few years, it occurred to me that it might not be amiss to review briefly a few incidents affecting the railroad and gėneral industrial situations as they confront us today. The railroads and the industrial and business activities of the country are so intimately related that anything that disturbs one is sure to disturb the other. Industrial and business activity depends very largely on the country's transportation facilities, and, conversely, the railroads depend, for their existence, upon the transportation of the products of industry. Take one away and the other dies.

Last year we were reminded that but a few months before, the railroads of the country had been returned to private control, and that war conditions had presented many serious problems with which the railroad managements would have to deal. Prior to the signing of the armistice, the prices of commodities, the necessities of life, building materials and labor had not advanced beyond what should naturally have been expected, due to the urgent demand for war materials and supplies necessary to maintain armies in the field. Had prices remained where they were then, the country would have been spared much of the worry and anxiety through which it has been struggling during the past three years. Unfortunately, a halt of reckless spending was not called following the termination of the war. Relaxation brought on a veritable pandemonium. The newly rich had been spending their money recklessly, the laboring people had set up false standards of living and demanded wages, which in pre-war days would never have been dreamed of, and under which industrial prosperity could not be maintained. In short, the mass of unthinking people, constituting a large percentage of our body politic, had gone mad in its scramble for more money with which it might indulge in a still greater orgy of spending. The easy money which came to labor, and the utter abandon with which it spent it, gave the cue to the mercantile classes. The result was a neck and neck race between spendthrifts and profiteers, which reached its climax about a year ago.

Trifling with economic laws had been carried too far; the stress on credit had begun to manifest itself, and the pendulum had begun to swing back. The day of reckoning had come, and the reckless expenditure of wealth and wages in automobiles, silks and furs and other ill-conceived items of so-called higher standards of living had been suddenly checked. The result was a heavy decline in the business activity of the country; mills and factories were forced to close down; a large percentage of the labor of the country was thrown out of employment, and the traffic of the railroads was greatly reduced. This in turn resulted in heavy reductions in the various departments of railway service, many being furloughed indefinitely, and others being placed on part time.

Until a few days ago I thought I saw a rift in the clouds and felt that a brighter and better day would soon dawn. Today when men's nerves are badly worn and the production and transportation of the country are almost at the lowest point; when the cost of living is still high, although the tendency of wages is downward; when absence of demand has closed factories and thrown millions out of work, we see the most highly organized branch of labor declaring that it will not accept the wage reductions ordered by the Railroad Labor Board and voting to strike.

At this point it might be interesting to review briefly the part union labor has already played in bringing the railroads of the country into their present unfortunate plight. About five years ago, Congress, under pressure, passed the eight hour law, the immediate effect of which was automatically to increase compensation without decreasing the hours of labor. This was brought about under the threat of a general strike when the country was menaced by war. When the country became involved in war, the brotherhoods again took advantage of the situation and coerced the Railroad Administration into granting increases aggregating over a billion dollars a year, and entering into compromising and embarrassing agreements as to working conditions. After the railroads had been returned to private control, and while the Interstate Commerce Commission was deliberating over an application for increased rates to comply with the new Interstate Commerce Act. the union again succeeded in getting still further increases aggregating over six hundred million dollars, resulting in an increase of about 25 per cent over and above the increases which would otherwise have been necessary. This last transaction was brought about under pressure of strikes in yards and shops, which greatly crippled

railway service. By this time the railroad labor unions had obtained a strangle hold not only on the government, but on the entire industrial and business structure of the country.

In the meantime, other branches of organized labor had not been idle, and it therefore felt itself so strongly entrenched, that it proceeded with its extortionary tactics, and for some two years compelled the public to witness an almost endless demand for increased wages. At the same time new working agreements, designed to restrict production and further increase the cost, were demanded. These increases were all reflected in the cost of production and passed on to the ultimate consumer. The result was a general curtailment along all lines of industrial activity. To the railroad labor unions must be attributed part of the responsibility for present high freight rates, and until there is a reduction in wages and bonuses, the people cannot hope to get cheaper transportation.

Referring to the threatened strike of railroad workers, Senator Nelson said, " Let the people understand once for all, what they mean by threatening to strike. Let them understand it means the stopping of food supplies and other essentials; want and starvation to our cities and towns, and I venture the statement, that the American people will rise up in their might and wipe these men from the earth."

Speaking recently on the unemployment situation, Senator Nelson declared that the workmen were responsible for most of the unemployment throughout the country, because they refused to consent to an adjustment of wages. As labor represents such a large percentage of the cost of every commodity, no material change in economic or industrial conditions can be brought about until labor is ready to do its part. He blamed the inactivity in the building industry almost wholly on the high wages paid workmen, and said he believed that if the bricklayers, carpenters and other building mechanics would come down from wages of eight to ten dollars a day, to four to five dollars a day, the country would see the greatest boom in the building industry in its history. Statistics show that with the increase in wages came a corresponding decrease in efficiency. What the railroads and indeed the whole world, needs and is entitled to, is a dollar's worth of work for every dollar expended, and they must have it, before normal conditions will return.

While it is true that the prices of steel, lumber and many

other construction materials have dropped quite appreciably, and that certain branches of labor have agreed to fair reductions, it is a sad commentary to witness the stand taken by other classes of labor engaged in the building industry. And this in the face of the fact that millions of their fellowmen are now unemployed. I appeal therefore for loyalty to your respective companies in these times of adversity.

According to figures recently issued by the Federal Reserve Board, the wholesale value of farm products has fallen to within 15 per cent of pre-war levels. When we consider that these products have reached the world markets by the payment of freight charges far in excess of pre-war rates, it is not difficult to see that the farmer is practically down to a pre-war income; in other words, that his income is about as nearly deflated as a child's balloon after an all-day sojourn at a county fair. This, however, cannot be generally said of the retail prices of food stuffs, made from the farm products, as they appear on the merchant's shelves under their new names. In other words, there is as yet hardly a speaking acquaintance between a bushel of wheat and a loaf of bread.

Assuming that the farmer was the first man down, he should consider himself fortunate. There are no smokeless chimneys above his great food factory. He has grown this year's crops at less cost than for several years past, and it is a safe bet, that there is not in this broad land today, a single bonafide farmer out of a job. What has been said of the farmer may, with equal propriety be said of the cotton planters of the southwest, who, when the slump came, were, in certain sections, caught with one-half to two-thirds of last year's crops on their hands, and are now selling cotton at prices not far above pre-war levels.

In sizing up the industrial situation, following the close of the world war, many people reasoned that as prices held up for some six or eight years following the close of the civil war, there was no reason why they would not in the present instance. Farmers and planters were urged to hold their crops for war prices. As a result, many of the granaries, elevators and warehouses of the country were well filled with last year's crops when this year's crops were harvested. In reaching their conclusions, they failed to realize that Europe was not involved in the civil war, and had money with which to purchase what this country had to offer. Today, after four years of war and waste in life and property, it is without money to buy even the necessities of life, to say nothing of what

might be considered luxuries. As a result we are suffering from over production, and until labor agrees to a readjustment conforming to economic laws, present conditions will continue.

In the final analysis, I am convinced that much of the trouble, distress and misery which harass the world today can be traced to selfishness and a misconception of the meaning of the little word "public." While it means "all the people," the average man is inclined to think it means the "rest of the people," but not himself, and therefore looks upon and thinks about the public as "other people." Yet he expects these other people to think his kind of thoughts, to speak his language and do his way. When they act otherwise, he is surprised and hurt. Unfortunately, he has never tried to see what kind of people the public is composed of.

In this country today there are over twenty-three million men, women and children, about one-fifth of the country's population, who think, talk and reason in foreign tongues. In this city alone there are 48 foreign language newspapers, representing nearly every nationality of the western hemisphere. While New York may be different in its cosmopolitan population from other cities, it is typical. The public is ever the same, made up of a varied mass of humanity, each entity with his or her own ideas, desires and limited experience; his or her own aims and ambitions. Therefore, no utility man, no business man of any kind, indeed no laboring man, can expect this public to measure rightly and sympathetically, his own ideas and purposes unless he presents them sufficiently clearly before the world for every kind of folk to understand.

And now a word to the members and those who will later become members. Your officers and committees have spent much time and thought in preparing for this convention. Arrangements for your comfort and entertainment have been completed. The reports represent much thought and labor, not to say personal sacrifice on the part of many. The benefits to be derived from them will rest entirely with the membership. They will be presented and discussed as far as time will permit, and it is hoped the members will give their undivided attention to the meetings and take part in the discussions.

Before closing, I venture the suggestion that the duties of the committee on subjects be extended to include that of assisting the president in selecting the personnel of the several committees. This suggestion is made for the reason that the president is not always sufficiently well acquainted with the entire membership to

enable him to select the men best fitted—to secure data on the various subjects presented for investigation and report.

In conclusion, I wish to state that I consider it a very great privilege to be permitted to preside over this convention, and I want to extend a hearty greeting to all our members and friends who are assembled here this morning. I can conceive of no more eloquent testimonial to the character of manhood of this association, than the fact that members are almost invariably accompanied by their wives and daughters at these annual gatherings. I trust the custom will never be abandoned, and that the ladies will continue to enjoy these meetings as in the past.

President Strouse:—We will now have the report of the secretary-treasurer.

REPORT OF THE SECRETARY-TREASURER

Since the last convention 1250 copies of the annual proceedings have been published and distributed to our members, our advertisers, prominent public libraries, universities, the Government and other places where we have had call for them.

Our association, like all others, has recovered very slowly from the effects of the war. This is noticeable not only in connection with committee work but in every phase of our work. However, we have many loyal workers who devote a great deal of their time and energy to our work, without whose assistance we would be able to make only a very poor showing.

Up to the present time the work of the secretary-treasurer has been conducted by one man (the secretary) in two rooms in his residence set aside for that purpose. The detail work has been too confining and the executive committee has wisely seen fit to allow compensation for a stenographer who also assists with the clerical work. A sufficient allowance was also made to enable the secretary to secure assistance in other ways, all of which was made possible only by increasing the amount of the annual dues.

It is probable that Mr. Weise will assist in the editing of the news Bulletin, and it is hoped that it may appear more regularly in the future and its usefulness be increased.

Death has removed from our midst ten of our members since the last convention. Suitable memoirs will appear in our proceedings as far as we are able to secure the necessary data.

The financial report follows:

Financial

Balance on hand last report		$1,309.75

Receipts

Dues and fees,	$2,077.00	
Advertising,	729.10	
Sale of badges,	63.50	
Sale of books,	5.00	
Interest,	39.25	
Total receipts,		$2,913.85
Total on hand and received,		$4,223.60

Disbursements

Postage,	$ 112.54	
Printing and engraving,	1,462.07	
Stationery and office supplies,	110.08	
Editing,	35.00	
Convention stenographer,	160.00	
Expenses various committees,	6.00	
Badges,	96.86	
Salaries and office rent,	1,365.75	
Convention expenses,	225.40	
Telephone and telegraph,	9.75	
Exchange,	9.40	
Miscellaneous,	21,54	
Total,		$3,614.39
Balance on hand,		$ 609.21

Respectfully submitted,
C. A. Lichty, Secy.-Treas.

The report was referred to the auditing committee, consisting of J. S. Robinson, G. K. Nuss and E. L. Sinclair.

Secretary Lichty introduced the three charter members present, John H. Markley, Adam McNab and George Hanks, and stated that George W. Andrews might also be included as he was made a member and was in attendance at the first annual convention held in Cincinnati in 1892. (Applause.)

REPORT OF MEMBERSHIP COMMITTEE

The committee on membership made a thorough canvass for new members, as a result of which we are able to present 65 applications.

The committee recommends the following list of applicants for active membership in the association.

Harry Sillcox, Chairman.

New Members

Airmet, J. S., Ptr. For., O. S. L. R. R., Nampa, Idaho.
Armstrong, Geo., For. B. & B., O. S. L. R. R., Nampa, Idaho.
Barber, A., For. B. & B., Mo. Pac. R. R., Gorham, Ill.
Best, H. H., Supv. B. & B., Mo. Pac. R. R.. Little Rock, Ark.
Bishop, F. J., Asst. Engr., L. S. & I. Ry., Marquette, Mich.
Crompton, F. F., Genl. For., O. S. L. R. R., Salt Lake City, Utah.
Comins, H. A., Supt. B. & B., B. & A. R. R., Houlton, Me.
Condon, F. O., Dist. Engr., Can. Nat. Rys., Moncton, N. B.
Cullen, J. L., For. B. & B., O. S. L. R. R., Pocatello, Idaho.
Cutler, A. C., Gen. Bldg. For., N. Y. N. H. & H. R. R., Hartford, Conn.
Dann, Henry, For. B. & B., O. S. L. R. R., Nampa, Idaho.
Doyle, J. A., B. & B. Mast., D. & H. R. R., Oneonta, N. Y.
Elfstrom, P. R., Asst. Engr., C. M. & St. P. Ry., Terre Haute, Ind.
Ellsworth, F. J., Asst. Supv. B. & B., N. Y. C. R. R., New York City.
Favreau, H., Br. Insp. & Desig., G. T. R., Montreal, Que.
Forney, H. L., Mast. Carp., B. & O. R. R., Pittsburgh, Pa.
Fraser, E. J., Supv. Bldgs., N. Y. C. R. R., Toledo, O.
Gray, Wm., Ptr. For., L. I. R. R., Jamaica, N. Y.
Gutelius, Jr., F. P., Div. Engr., D. & H. Co., Plattsburg, N. Y.
Hardiman, Wm., Genl. For. B. & B., D. L. & W. R. R., Binghamton, N. Y.
Heck, R. G., Asst. Engr., C. M. & St. P. Ry., Savanna, Ill.
Heron, T. N., Asst. Engr., A. & V. R. R., Vicksburg, Miss.
Holtman, D. F., Const. Engr., Nat. Lbr. Mfrs. Asso., Washington, D. C.
Howe, W. H., Mast. Carp., B. & O. R. R., Seymour, Ind.
Jack, J. A., Br. Insp., N. Y. C. R. R., New York City.
Jacobs, C. E., Supv. B. & B., L. V. R. R., Jersey City, N. J.
Jameson, W. R., Carp. For., N. Y. C. R. R., New York City.
Jamieson, Robt., Mast. Carp., B. & O. R. R., Baltimore, Md.
Johnson, E. A., Supt. B. & B. Me. Cent. R. R., Bangor, Me.
Kemp, T. D., Asst. Engr. M. of W., Sou. Ry., Charlotte, N. C.
Kimball, L. P., Engr. Bldgs., B. & O. R. R., Baltimore, Md.
Kirkpatrick, T. M., For. B. & B., Mo. Pac. R. R., Herrin, Ill.
Lair, W. S., For. Carp., P. R. R., Morrisville, Pa.
Lang, P. G., Jr., Engr. Brdgs., B. & O. R. R., Baltimore, Md.
Larson, O. J., For. B. & B., O S L. R. R., Cokeville, Wyo.
Love, W. E., Mast. Carp., B. & O. R. R., Connellsville, Pa.
Lowe, J. S., Supv. B. & B., N. Y. N. H. & H. R. R., Boston.
Lunday, T. O., Supv. B. & B., U. P. R. R., Kansas City, Mo.
Meers, W. L., For. B. &. B., W. Pac. Ry., Elko, Nev.
Meyer, Wm., Asst. Engr., C. & N. W. Ry., Chicago.
Mitchell, R. W., Mast. Carp., B. & O. R. R., Baltimore, Md.
Nelson, C. T., Supv. Metal Brgs., A. C. L. R. R., Florence, S. C.
Norrell, R. R., Supv. B. & B., Sou. Ry., Birmingham, Ala.
Norris, W. H., Br. Engr., Me. Cent. R. R., Portland, Me.
Osler, C. E., Insp. Engr., G. T. Ry., Montreal, Que.
Peterson, Carl, For. B. & B., Sou. Pac. Co., Bakersfield, Cal.
Phelan, P. J., Supv. B. & B., G. T. Ry., Montreal, Que.
Pitcher, F. J., Asst. Engr. Strs., N. Y. N. H. & H. R. R., New Haven.

Pullar, James, Asst. Engr., Can. Nat. Rys., Moncton, N. B.
Schantl, Hans, Chief Engr., M. R. & B. T. R. R., Bonne Terre, Mo.
Shively, Wm., Mast. of Brgs., C. R. R. of N. J., Jersey City, N. J.
Shuman, W. H., Asst. Supv. B. & B., C. & N. W. Ry., Adams, Wis.
Spencer, P. B., Engr. Strs., N. Y. N. H. & H. R. R., New Haven.
Stewart, B. J., For. B. & B., O. S. L. R. R., Salt Lake City, Utah.
Thomas, G. G., Engr. Brdgs., A. C. L. R. R., Wilmington, N. C.
Tompkins, R. E., Bldg. For., N Y. N. H. & H. R. R., Danbury, Conn.
Tomlinson, B. V., Gen. Carp. For., P. R. R. Trenton, N. J.
Trombly, J. A., Dist. For., N. Y. N. H. & H. R. R., Hartford, Conn.
Underwood, H. B., For. B. & B., W. Pac. R. R., Elko, Nev.
Walsh, R. J., Bldg. Insp., N. Y. C. R. R., New York (470 W. 30th.)
Wells, J. M., For. W. S., O. S. L. R. R., Salt Lake City, Utah.
Wheaton, F. L., Div. Engr., D. L. & W. R. R., Buffalo, N. Y.
Whitmore, Henry, For. B. & B., O. S. L. R. R., Nampa, Idaho.
Wilhelm, L. C., Genl. For., L. V. R. R. Easton, Pa.
Woolley, B. O., Asst. Supv. B. & B., Sou. Ry., Gainesville, Ga.
Total new members, 65.

The secretary was authorized to cast the vote electing the foregoing list of applicants to membership, after which those present were urged to take an active interest in the work of the convention.

F. E. Weise was appointed assistant secretary during the convention.

The president stated that inasmuch as the minutes of the last meeting were printed in the proceedings, their reading at this time would be omitted and they would stand approved unless corrections or additions were ordered.

The minutes of the executive committee were accepted in like manner.

The committee on obituaries reported as follows:

REPORT OF OBITUARY COMMITTEE

It is with deep regret that we are again called to note the work of the Grim Reaper during the year preceding this 1921 convention. The march of time cannot be controlled by human agencies and we are therefore called upon from time to time to record our losses and suffer our bereavements. Yet in our sorrow we must not murmur against the omnipotent power that governs all things, realizing as we do that we are in the hands of our Heavenly Father, who doeth all things well. While we bow our heads in obedience to this decree, let our hearts go out in sympathy to the bereaved families and friends of our well beloved brothers and comrades who are to meet with us no more until we too shall have crossed the Great Divide that now for a brief time separates us. Therefore, be it

RESOLVED, That this association hereby tenders its heartfelt sympathy and condolence to the families of these, our deceased brothers, in their bereavement, with an earnest and humble prayer that our loving Heavenly Father may guard and comfort them in their affliction, and be it further

RESOLVED, That a copy of these resolutions be entered in our

proceedings as a tribute to and in remembrance of these our departed brothers and that a copy be sent to the family of each brother who has gone to his eternal reward during the past year.

P. J. O'Neill,
Geo. W. Rear,
Committee.

The registration showed the following members present:

REGISTRATION

N. C. Ailes
L. B. Alexander
L. J. Anderson
August Anderson
Geo. W. Andrews
F. C. Baluss
O. F. Barnes
M. M. Barton
Amos H. Beard
L. Beck
L. M. Blake
S. H. Blowers
S. C. Bowers
F. R. Bourquin
E. E. Brink
J. B. Browne
J. E. Buckley
M. Burpee
E. Cahill
W. M. Camp
J. P. Canty
F. M. Case
A. J. Catchot
J. B. Clarke
A. S. Clopton
F. J. Conn
J. F. Cookingham
A. C. Copland
W. C. Corbin
L. A. Cowsert
James Dupree
E. A. Demars
Leo J. Denz
W. L. Derr
R. G. Develin
P. Doyle
E. Drury
Paul Eberst
E. Eldrige,
F. A. Eskridge
D. D. Everett
C. H. Fake
R. F. Farlow
Geo. Fenwick
Albert Fink
L. M. Firehammer
A. Fraser
Franklin Gable
B. F. Gehr
Ira Gentis
E. L. Goldsmith
Chas. Gradt,
F. N. Graham
Neal Gregory
F. M. Griffith
L. D. Hadwen
G. E. Hanks
A. W. Harlow
O. J. Hein
R. H. Helick
J. Henderson
R. C. Henderson
U. S. Hitesman
F. W. Hillman
Peter Hofecker
Geo. M. Hoffman
E. H. Howson
A. T. Humbert
J. S. Huntoon
J. Hunciker
A. B. Ilsley
J. Innes
W. J. Jackson
R. E. James
J. O. Jewell
B. L. Johnson
C. H. Johnson
E. H. Johnson
Maro Johnson
H. C. Keith
A. E. Kemp
E. Kimmel
H. H. Kinzie
G. J. Klumpp
F. A. Knapp
C. R. Knowles
N. H. LaFountain
W. V. Lattin
E. K. Lawrence
A. Leslie
M. J. Loeffler
E. L. Loftin
Geo. Loughnane
C. A. Lichty
Wm. Mahan
G. A. Manthey
J. H. Markley
G. C. McCue
E. M. McCabe
A. G. McKay
D. L. McKee
Robt. McKibben
A. McNab
R. P. Mills
G. Montgomery
Homer Morgan
Theo. Morin
E. C. Neville
E. O. Newton
G. K. Nuss
T. E. O'Brien
J. W. O'Neil
J. A. Owen
J. F. Parker
K. Peabody
C. Pettis
W. A. Pettis
J. L. Pickles
R. Pierce
A. K. Potter
W. F. Rankin
C. P. Rawson
D. L. Rehmert
Edwin Reese
A. Ridgway
R. H. Reid
A. W. Reynolds
M. Riney
J. S. Robinson
John Robinson
G. A. Rodman
D. Rounseville
F. E. Schall
A. B. Scowden
F. E. Shanklin
C. A. Sibley
Harry Sillcox
E. L. Sinclair
E. P. Self
F. H. Soothill
L. K. Sorenson
C. U. Smith
M. A. Smith
E. G. Storck
J. J. Steadham
W. A. Stewart
P. F. Solan
W. F. Strouse
T. H. Strate
Jos. Spencer

A. M. Swenson
H. C. Swartz
H. B. Stuart
S. C. Tanner
D. B. Taylor
F. A. Taylor
J. J. Taylor
E. E. Templin
M. E. Thomas
S. B. Thorn
O. C. Till
J. E. Toohey
T. B. Turnbull
W. W. Turnbull
W. J. Tyers
O. E. Ullery
L. J. Wackerle
C. F. Warcup
P. N. Watson
Chas. Wehlen
F. E. Weise
D. T. Wells
E. R. Wenner
Geo. W. Welker
Geo. Y. Whitmee
Warren Wicks
J. C. Williams
J. Wilson
J. J. Wishart
C. F. Womeldorf
J. P. Wood
C. W. Wright
Hubert Wuerth
W. B. Yereance
E. C. Zinsmeister

The following list of applicants, subsequently elected to membership, were also present.

F. J. Bishop
H. A. Comins
A. C. Cutler
Jno. A. Doyle
F. J. Ellsworth
H. Favreau
E. J. Fraser
Wm. Gray
Wm. Hardiman
R. G. Heck
T. N. Heron
J. A. Jack
E. A. Johnson
L. P. Kimball
J. S. Lowe
R. W. Mitchell
W. H. Norris
C. E. Osler
P. J. Phelan
Andrew D. Shreve
R. E. Tompkins
J. A. Trombly
R. J. Walsh

Total number registered, 207.

Letters and telegrams were received from a number of members who were unable to be present, among whom were A. E. Killam, A. B. McVay, W. A. McGonagle, J. S. Lemond, Geo. W. Rear, Frank Ingalls and W. O. Eggleston.

President Strouse announced that there was no further business to be presented before taking up the regular subjects for report and discussion. Adjournment was then taken at 12:30.

AFTERNOON SESSION

Tuesday, Oct. 18, 1921.

The afternoon session was called to order by President Strouse at 2 o'clock.

The first report taken up was Tool Equipment for Pile Driver Outfits. In the absence of the chairman, J. A. Bohland, the secretary read the report. (See report and discussion.)

The next subject taken up was that of Recruiting of Bridge and Building Employes. (See report and discussion.)

The report was read by the secretary.

The report on Detection and Repairs of Leaks in Water Mains was presented by C. R. Knowles (chairman) who read the report and opened the discussion. (See report and discussion.)

The convention adjourned at 5 o'clock to meet in evening session at 7:30.

EVENING SESSION

Tuesday, Oct. 18, 1921.

President Strouse called the meeting to order at 7:45.

C. M. Taylor, superintendent of timber preservation of the Central Railroad of New Jersey and the Philadelphia & Reading gave an illustrated talk on The Treatment of Bridge and Building Timber, which was followed by discussion. (See remarks and discussion.)

WEDNESDAY MORNING

Wednesday, Oct. 19, 1921.

The meeting convened at 9:45, President Strouse presiding.

President Strouse:—Several weeks ago the secretary wrote me asking whom I would recommend to give us a talk during the convention on some railroad topic of interest. I replied that I knew of no one who could do this better than Mr. L. F. Loree, of New York, president of the Delaware and Hudson Company. Mr. Loree has consented to do this, and I take great pleasure in presenting Mr. Loree at this time, who will tell us of the development of early railroading.

EARLY DEVELOPMENT OF RAILROADS

(By L. F. Loree)

I have always had a peculiar sympathy with bridge men. The first job I got on a railroad was as a rodman on the New York division of the Pennsylvania at $35 a month. I used to see (and still do) in the papers that "George Smith has accepted a position with the Filene Grocery Company." I didn't have any such thing in mind at that time. I hadn't accepted a position. I had gotten a job, and jobs were hard to get after the panic of 1873. Business was reviving slowly; there were a great many idle men; there was almost no new construction, and I had secured a job when jobs were scarce. I hadn't had the job more than a fortnight I think before the bridge over the Raritan River caught fire and burned. It so happened that the Pennsylvania Railroad had begun the reconstruction of the bridge. They had a steel draw span ready to swing into place on the following Sunday, and I had been out there the previous week making a lot of notes with the engineer; holding one end of the tape while he did the brain work. I was somewhat familiar with the situation. The most difficult part of the reconstruction was out of the way so all that had to

be done was to put the span into place. When I got into the office in the morning after the fire, the engineer was busy assembling material and men; sending telegrams; sending out purchasing orders; and doing the usual routine work. He called me in and I sat at one corner of his desk and pushed a pencil until two o'clock, getting a piece of pie and a glass of milk on the side. He then took me out with him, and I put in my first 24-hour job. We were on the job 36 hours before he thought fit to knock off, and as I couldn't get away, and as I was very much interested, I stayed.

The last work of that kind I think that I saw was on the Panhandle. I was general manager at Pittsburgh. We had a very severe storm in the Muskegon, and it carried out a lot of the track and the bridge over the river. I stayed in the office for a little time, diverting the traffic, making the detour arrangements, getting the men and material assembled, and when that was through, I got in my car and went out on the ground. After I had been there about a day, we all felt that we could say when we could open up traffic. I went into the telegraph office to reverse all the arrangements I had previously made, issuing orders for the return of the traffic to its normal routing, and making arrangements for the return of the men and material to their home station. While I was at the work, I noticed that the telegraph operator stopped work. I said to him, "Jimmy, what is the matter?"

"Why," he said, "they took the wire away from me on the thirty-eight signal."

I said, "Who did it?"

"Strouds did it." Strouds was a little station, with perhaps 50 houses, on one of the western divisions.

I said, "What is he sending in?"

"He is sending in the delayed weather reports." (Laughter.)

That is a type of the things we meet every day on the railroad, so ridiculous that nobody but a railroad man would believe it. I took the wire away from him with the president's forty-one signal. Later I spent a couple of days going over the wire work, and I hope that that sort of thing didn't happen again for some time.

I could go on with reminiscences about my association with bridge work and be more entertaining perhaps than useful. Last August I was in England. I motored over through North Wales to look at a bridge over the Menai Straits which was built by Telford in 1824. It is a highway suspension bridge with eye-bar links,

and still in very good condition. I don't see why it shouldn't last a good deal longer than its present life, but it filled me with an impression of the recentness of everything.

A little later I drove down the old King's Highway that ran from London to Hollyhead, and which also was built by Telford, and which he laid out as we lay out a railroad, with calculated grades and curves, and fit it to the country. The roads that we have today are largely the thought of Telford and McAdam, and yet it is less than a hundred years ago that those men were in their busiest activity. Since then, of course, a very great change has taken place, especially in the kinds of material we use. We use alloy steel in bridge construction. There are a great many changes in things of that character.

The other day Mr. Waddell sent me a complimentary copy of his latest book which he says is going to be his last, though I hope not, and if any of you have a taste for mathematics, I suggest that you get it and study it. There is a great deal of it which does not need mathematics to understand, and he has a great many practical suggestions in connection with bridge work. Perhaps he has had as large an experience as any one in this country and he is one of the men who I think never has lost the practical view of bridge construction.

I remember when I first went down over the Kansas City Southern being very much impressed with some short A bridges they had. There were spans of perhaps 70 to 125 ft. He had run his A truss up into the air 30 or 40 ft., but he had everything that made the bridge quite as good as a girder would have been if that had been substituted.

I don't think that what I would have to say on this subject, with the long period of detachment I have had from the detail of it, would be particularly instructive. Having in mind what I said about my visit to Menai Straits, I thought perhaps if I said something about the way in which all this came about, it might have more real interest, because the difference between the modern world and the ancient world is so great and so recent that we have difficulty in fitting ourselves to it. That is one of our real troubles—to get into the new relations.

You will remember that Columbus discovered America in 1492. It was not until almost 150 years after that, 1641, when Galileo found out that the air had weight. Nobody up to that time thought the air weighed anything. They thought it had peculiar properties

and would move about and fill in wherever there was a vacuum. His attention was attracted to the subject by the fact that somebody put a suction pump in his neighborhood and couldn't hoist water over 30 ft. He went and looked wise and said that that law of "air abhorring a vacuum" didn't work when it got over 30 ft. That satisfied most people, but it didn't satisfy him. When he got home he sat down to think the subject out. He made some experiments, and made up his mind that the air had weight, that that was the reason it got into these holes. When he died, which he did a year or two afterwards, one of his students, Torricelli, continued his experiments. He reasoned that if air would support water in a vacuum to a height of 32 ft., mercury weighing 14 times as much as water would have a much shorter column, and he tried that out and found that was the case. So he demonstrated with a philosophical experiment that air had weight, and, measured in columns of water or mercury, he knew how much it weighed. That became generally known all over Europe, and finally a man named Von Guericke invented an air pump.

They wondered how they could use this weight. They built a cylinder and a piston and until we recently developed the internal combustion engines and turbines, that was all we had—a cylinder and a piston. This air pump was designed for the purpose of pulling the air out of the cylinder under the piston whereupon the atmospheric pressure would push the piston head down and by making a rope fast to the piston rod and over a couple of pulleys, he lifted a couple of boys as high as the stroke of the piston went.

It was perhaps 10 or 15 years after that when a Dutchman named Huygens tried to get the air out, not by an air pump, but by driving the air out through the orifice by the explosion of gunpowder. He succeeded in lifting 1600 lbs. by exploding about a thimbleful of gunpowder but the trouble was he couldn't keep doing it. He could do it once, and probably again 15 minutes afterwards, but he didn't have any continuous power.

He had a student named Papin, who suggested that perhaps if they used steam, they could get the air out that way. That came to the attention of a man named Newcomen, an iron merchant in Darlington, England, and he worked out the first atmospheric engine or fire engine in 1712, only about 209 years ago.

First he built his cylinder and his piston and piston rod, and then he had what he called a working beam actuated by the rod of the pump. He let the steam in under the piston, drove the piston

up, and the weight on the other side helped to pull it up. Then he condensed the steam by letting in a stream of cold water, turned a cock and let the water he put in there and the water from the condensation of the steam, go out, and then the atmospheric pressure pushed the piston head down. That motion could be repeated and his engine went into use.

He got a working pressure of about 7 lb. to the square inch. He built his cylinder very big. His best pump had a cylinder 72 in. in diameter, and had a stroke of 5 or 6 ft. They got down to a depth of 300 or 400 ft. They went into use for pumping mines; the coal mines in the north of England; the tin and copper mines in Cornwall. Apparently as many as 100 of them came into use in the coal mines of that country, and about 60 in the copper and tin mines. He had his troubles, of course. We talk about things getting water-logged. They talked about getting air-logged. They were ingenious people; good mechanics. They went at their troubles and worked them out.

There was a man named James Watt in Glasgow who began to serve an apprenticeship as a mechanic. He worked there about a year, then went down to London, worked there about a year, and came back and tried to open up a shop in Glasgow. They had their trade union restrictions in those days though called by a different name. As he was neither the son of a burgess nor had served his apprenticeship he wasn't allowed to go ahead. He got a job as a mathematical instrument maker in the university. They had their own laws, so he lived inside the university grounds and went to work.

After he had been there a year their model of a Newcomen engine needed repairs. He was very much astonished at the amount of steam it used. So he went to work to find out what the trouble was and he concluded the real trouble was that so much of the condensation took place because the walls of the cylinder were cold and before it had time to push up the piston, a lot of it had been lost and condensed. If he could take that steam outside and condense it in an outside chamber instead of inside the cylinder, he could use less steam. As a matter of fact, he cut down the steam consumption about a quarter, in the end about 40 per cent, by condensing it in an outside condensing chamber, and then he concluded that if he wrapped the whole thing in a steam jacket, he would not need to be troubled by the outside cold of the atmosphere. Therefore, he put it into a steam jacket, and then it occurred to

him that he could let the steam run on the top of the cylinder, making a double acting engine. He let the steam first under then over the piston and got his motion by that double action.

The minute he got that he was able to get a rotating motion. Nobody had been able to get a rotating engine before. When he got a rotating action, it could be applied to machinery of any kind. He took out patents from 1765 to 1782. He was very fortunate in having associated with him a man named Boulton, who had been engaged in iron work at Soho, one of the suburbs of Birmingham, a man of great business courage, considerable capital, and absolute confidence in Watt.

In this way, Watt was able to give his whole time to the mechanical side of his business without thinking about the business side, although he was a pretty keen business man. He built his business on the basis of making a thoroughly good engine and controlling the devices by patents which ran about 25 years. In six years he drove all the other engines out of business, and he did it by a mercantile proposition. He went to the mines and said, "How much coal are you using to run this engine?" They told him. "All right, if you will give me one-third of that, I will get you the same results."

He went in, dividing with them, of course, and both he and Boulton made great fortunes.

Now, everything in this world has a kick-back; as we say in the mathematical side, the action and reaction are always equal. It doesn't always work quite that way. There is always some reaction and one of the troubles about the monopoly of patents is that they exclude everybody else. Therefore, once Watt got into possession of the field, nobody else had any chance to work. The minute his patent ran out, a lot of people were ready to step in. He had a lot of infringements, and he drove some people out of the field with patent suits. There was a man named Hornblower whom he sued for as high as $200,000 license fees.

When the patent ran out, a man named Trevithick had an idea that steam could be used for locomotion, and he applied it first to a steam carriage to run on the highway and later applied it to a steam locomotive to run on a railroad. Railroads or what we would now call tram roads were beginning to be built about 1761. They used them to take coal to the water's side for loading on vessels. With a good horse they would pull down 4000 lbs., but then they had to pull the carriage back. They went on improving that.

They put a strap rail on the wooden stringers and took the flange off the outside of the wheel and put it on the inside. Iron rails were put in about 1774. They still went on improving. There wasn't any fundamental trouble in Trevithick's locomotive except its weight. It broke all the iron rails. It was a good deal better than the road was. That complaint still goes on. You know the maintenance of equipment engineers, are always complaining about the bridges and the track. They say we don't keep up with the game. That was Trevithick's trouble. The track wasn't good enough.

Various people began to improve on Trevithick's idea. Hedley had bought one of Trevithick's smooth wheel engines which he further improved. Blenkinsop built an engine to run on a rack-rail, and that engine was in use as late as 1830 in England. Chapman built an engine. He put a barrel under it. The barrel picked up a long chain, fastened at either end with two or three wraps, and as the barrel went along, the friction was enough that the engine pulled itself on the chain. Today short ferry lines operate that way. In the Elbe River in Germany where the current is rapid they have tow-boats that take the canal boats and other freight vessels up the river for 30 or 40 miles, picking up a chain and winding themselves up the river. You can find scattered around the world pretty much everything we have ever had if you go looking for it, and when you go to look for it and see it, it looks good. It commands your respect, to realize what the people who went before us were able to do with their materials of construction. One of the troubles they had was the inability to keep up steam and that was finally overcome by Hackworth who turned the steam into the chimney. It had been done before, but he choked it down with a nozzle so he got a forced blast and that cured that trouble.

The first commercial railroad was the Stockton and Darlington, about 40 miles long, built by a lot of Quakers who lived in the neighborhood, and headed by a man named Pease, belonging to one of the leading families, descendants of which are still there and were very prominent all through the war in charitable work, looking after the hospitals and the lost and missing soldiers, doing work of that character, although a pacifist by religion and not from fear.

George Stephenson had been brought up in the service of the Wylam Collieries Company. At first he was a fireman and then

got to running the engine and finally what they called an engine-wright. Now, we would call him a mechanical engineer.

My father was a millwright. You don't hear about millwrights or engine-wrights any more. We have a general name, mechanical engineer, that covers pretty nearly all of those mechanical activities. Stephenson built a locomotive and used many of the ideas of Blenkinsop. He also used many of the ideas of Hedley and Trevithick before him, and he made a good engine as early as 1814.

Hearing that the Stockton and Darlington road was going to be built, Stephenson with Nicholas Wood, who was a colliery-viewer, or what we would call in these days a mining engineer, went to see Pease to get the job of chief engineer. They started out and walked 10 miles to get a coach to ride 30 miles, then walked 12 miles across the field where the first work was to be done, to see Mr. Pease. He got the job.

After a while some people promoted a railroad from Liverpool to Manchester. Manchester was a great manufacturing town; Liverpool was a seaport. They were 30 miles apart. They thought they could handle 800 people a day in each direction, or 1600 in all; and they thought they could handle 3000 tons of freight in each direction. That was the business they had in sight.

They decided they would build a double track railroad, and it was some railroad. In the first place, they had a tunnel a mile and a half long; a grade of one and a quarter per cent, up which the engine could pull itself, but couldn't pull the load, so they had to hoist the load with a cable. It is said that the first skew bridge ever put up was erected on the Manchester and Liverpool by Daniel Gooch. There were about 60 bridges in all. They had deep cuts, one through 100 ft. of limestone in the worst place. They had 4 miles of track across a marsh that no man could step on. They floated the track by putting down a mattress and building the track on the mattress. Think of that, the first real railroad, in 1830. They went up against nearly all the hard problems that you men have been up against.

They had some discussion as to how they would operate, whether they would put on engines or use horses. Horses were very much in use. It wasn't until Hackworth put in his forced blast that the locomotive really got on top of the game. The horse was doing the work about as cheaply and much more regularly. They concluded they would offer some prizes and see what the people interested in

locomotives could do. They offered a $2500 prize, drew their specifications and set a date. They got all sorts of suggestions as to what they ought to do and how to do it, and when the day came, five people showed up to enter the contest.

One man came with an engine that worked like a treadmill, the horse running on the treadmill floor, and setting in motion the gears, which turned the wheels and that ran the engine. This was ruled out as not coming within the specifications. The Perseverance, built by Burstall, could not attain the specified speed and was withdrawn. There was another engine named the Novelty that broke down and was withdrawn, which was built by Ericsson, who afterward built the armored turret war ship, the Monitor.

There were only two real engines in the contest. One was called the Sanspareil built by Timothy Hackworth. It made two round trips on the trial. My recollection is that the trial course was a mile and a half long. It went off with a flying start, pulling one way and pushing the other ten round trips. It burst a cylinder the first day. They wrapped the cylinder and got it in shape and then the next day something went wrong with the pump. So the Sanspareil, the thing without any superior, petered out. It was a pretty good engine, however. It was put back in service and ran until 1817 on a coal railroad, and then it was dismounted and run on a pumping machine. You can see it today in the South Kensington museum.

Stephenson's boy, Robert, had grown up by that time, and between them they built a good engine, the Rocket. It made a speed of 20 miles an hour and pulled 30 tons. It ran back and forth, pleased everybody and won the prize. The distinctive thing about the Rocket was that it had a multitubular flue in the boiler. Booth was the secretary of the company, and it was at his suggestion that they put 25 tubes in the boiler of the Rocket. They had no trouble making steam. They ran it for 8 years and sold it to another company where it stayed in service until about the time of the Civil War, and it is now in the British museum. It is today very much what it was then. They have dropped the cylinders which sat at an angle of 45 degrees, and it looked to me as if they had drawn them down to 10 degrees. That engine on one occasion attained a speed as high as 50 miles an hour, so it really was a good deal of an engine.

This, in a general way, is the history of steam railroad transportation. What has been done since? We have increased the steam

pressures enormously. Watt got a steam pressure of about 18 lb. with his outside condensing chamber. Trevithick got a steam pressure of about 30 lb. and discharged his steam into the open air, and that is where we get the name high pressure because he had to have pressure enough not to go into the vacuum, but to overcome the atmospheric pressure. We have high pressure; we have the compound engine; we have super-heated steam; we have improved the engine in many ways, but they are not so fundamental as these things I have been talking about.

Our trouble today is not so much our material as our men. When you think of the great changes that a few hundred years have brought in the physical world, it doesn't seem to me remarkable that men should find great difficulty in adjusting themselves to those changes; some of which have been very violent and very sudden. We had a stagecoach line running between New York and Philadelphia. A lot of people had their money in it, my mother's grandfather was a shareholder, but the day the railroads opened, that business was ruined. All those men had to get out of that business. The post houses were nearly all closed; the country taverns went out of business; horses and stages were sold off. People took to the new mode of transportation. That is only an example of a thousand. We are in a constant seething, whirling, moving condition in which naturally there is going to be a great deal of discontent and unhappiness, and the thing we ought to do is to find ways to ameliorate those things as much as possible; make them as small as possible; take care of them with as much patience and humanity as we can. The remarkable thing and the saving thing about it to my mind is that all these changes make for increased employment. Apparently, no matter what the improvement is, it puts more men to work.

Now, growing out of those changes there have been built up in the last 80 years two radical extremes of thought that have attracted a great many men, that have exerted a good deal of influence, and that have been regarded with a good deal of seriousness. One radical stream of thought is Socialism. Robert Dale Owen, who had a cotton mill at New Lanark in the North of England, began to take a great interest in his workmen. He built model tenements; he undertook good ventilation; put toilet facilities around his plant and did a great many of the things we think should be done today, and then like so many people who attract public attention, it went to his head and he lost his mental balance. He went into

all sorts of experiments. He came over here to the United States, went into Indiana and founded a socialistic colony called Harmony, and then broke up.

The man who systematized that stream of thought was Karl Marx, a German Jew, a man who had never had any practical experience in life, a man who spent most of his time in the British Museum reading what other men said they had done. He standardized the socialistic philosophy. That has been acted upon by a great many people. It is having its real, practical try-out in Russia today. The consequences of that experiment have been so dreadful that it has practically driven all the men of real character and intelligence away from the idea. You can't get any of the educated Socialists in this country who up to four or five years ago were very confident of the reasonableness and practicality of those theories to say a word for them today. The Socialist propaganda is, to my mind, a dead issue, not likely ever to trouble us again.

The other radical stream of thought is trade unionism, built on an entirely different conception. Socialism was a democracy run mad. It was democratic because it put everybody on the same plane. It pulled the high people down but it could not raise the low. It was democratic in the sense of being as uniform as a machine product.

Trade unionism is a caste proposition, not so definite as the Hindus who think they are defiled if somebody else casts a shadow on them; who can't eat food prepared by somebody else without defilement. Trade unionism has not gone quite so far as that, but has all the real characteristics of a caste proposition. Except the members, their brotherhood, nobody means anything. Nobody has a right to anything until they have first helped themselves. That organization began to have strength about 1840, some 80 years ago. It owes its strength very largely to its insurance feature, and its class of paid officials who have no other function than to carry on its business.

It has developed all the characteristic defects of a political organization. I remember as a boy the only way we could get an honest count of a free ballot in one of the wards, was to make an arrangement with John Morrison, a professional pugilist. He hired a bunch of plug-uglies, and they sat in the booths and scared out everybody who came to raise a row.

A lady used to visit my family who had one boy, a nice chap. He went over as a watcher during one election. He died

of consumption caused from being kicked in the chest, which injured his lung. That is the kind of thing we used to have in politics.

Trade unionism has all the defects of a political organization because it has a paid class of officers whose jobs depend upon satisfying the more active and less intelligent men in their organization.

I don't feel hopeless about that situation at all. I am a great believer in letting the light in. When I was a boy and walked up and down the streets here in New York, when a man got ready to close his shop he put up the shutters, a great iron bar over the door, and so on. That was the way he protected himself against thieves. I lived to see the time come when he took the shutters down and put them away, moved the safe up to the window, turned on the gaslight and went home. Who would think of breaking into his safe when everybody going along the street could see it? That is a cure, to my mind, for most of the ills of this life.

I have no fear that if we had a secret ballot and an honest count any brotherhood could ever carry a strike vote in this country. I don't believe they could do it today. The machinists in one of the shops took a strike vote a month or so ago. They went around and said quite openly, "If you don't vote for a strike, we will see that you are chucked out of the shop."

When they count the vote they go into the back room of some hotel, and only they know how they count them. You know how the count of our political vote now takes place, in the open and before watchers, and then we don't always know. I would like very much to see a real, honest-to-God strike vote on a defined issue under secret ballot and under honest count. I think we would all be surprised at the results. I think that would be very different from anything we have ever had.

I have taken a good deal of your time. I have taken a very great interest in you men. I think you have to realize the burden of preserving order and peace on these railroad properties is very largely your burden, and not mine. You are the men in immediate contact, and don't think that the authority you have is anything to be ashamed of or a thing that isn't worth while. The civilization we have is an industrial civilization influenced largely by the use of steam power.

In principle, this civilization is founded on three things: The institution of family; a family isn't anything you need be ashamed of. The institution of property; is property a thing to be ashamed of? When two men earn a dollar they both earn it in the same

way. One spends it all. One saves a part of it. In the source from which the dollar comes there is no difference. In the use made of the dollar there is a difference. There is nothing to be ashamed of in having saved a dollar, if you use it properly.

All the things that make modern civilization are due to those savings. That is the only way we can have them. There is nothing to be ashamed of about private property. It represents sacrifice; it represents putting off the thing that you would like to have, and doing without it, and it is put to the use of other people.

The third thing that made civilization possible is a government founded on justice and morality. Is there anything to be ashamed of about that? Don't we want justice? Don't we want good morals? We have had sinks of immorality. The Lord had no trouble in indicting Sodom and Gomorrah, and he executed his sentence. He destroyed them. Nobody wants to live in a sink of immorality.

Those three things are the fundamentals of our civilization, and they have produced unparalleled results. A hundred years ago they talked about a generation and they meant 30 years; that is, the average life that a man lived after he got past his childhood. They still talk about a generation, but we have so progressed that a generation today is about 45 years. We have added 50 per cent to the average life of mankind in the last hundred years and we have saved half the children in the last 20 years. Twenty years ago 158 out of every thousand, died in infancy. Last year 80 died. We have cut the infant mortality in two. Isn't it worth while?

We have had a total failure in Socialism, and I think we are rid of it, but what we have to do before we get real peace and comfort and can go ahead with security, is to put union labor into a position where it will behave itself. I think that work is up to you. (Applause.)

REPORT OF AUDITING COMMITTEE

New York, Oct. 17, 1921.

The committee appointed by the president to audit the books and accounts of the secretary-treasurer finds them correct as shown in the report presented to the association.

Respectfully submitted, J. S. Robinson,
G. K. Nuss,
E. L. Sinclair,
Committee.

The report on the Construction and Maintenance of Cinder Pits was presented by G. K. Nuss, chairman of the committee (See report and discussion.)

The report of the nominating committee was read by the chairman, F. E. Weise.

REPORT OF NOMINATING COMMITTEE

To the members in convention assembled: The committee on nominations after due consideration recommends the following for officers for the ensuing year:

President, C. R. Knowles, Illinois Central, Chicago; first vice-president, Arthur Ridgway, Denver and Rio Grande, Denver, Col.; second vice-president, J. S. Robinson, Chicago & Northwestern, Chicago; third vice-president, J. P. Wood, Pere Marquette, Saginaw, Mich.; fourth vice-president, C. W. Wright, Long Island, Jamaica, N. Y.; secretary-treasurer, C. A. Lichty, Chicago & Northwestern, Chicago.

Directors for two years, F. C. Baluss, Duluth, Missabe & Northern, Duluth; Maro Johnson, Illinois Central, Chicago, and O. F. Dalstrom, Chicago & Northwestern, Chicago.

Respectfully submitted,

F. E. Weise, Chairman.

Meeting adjourned at 12 o'clock.

AFTERNOON SESSION

Wednesday, October 19, 1921.

Meeting called to order at 2:15 p. m., by President Strouse.

The report on The Construction and Maintenance of Passenger Platforms was read by the chairman of the committee, F. E. Weise. (See report and discussion.)

The report on the Lining of Tunnels Under Traffic was read by the secretary, in the absence of the chairman, and was followed by discussion. (See report and discussion.)

Adjournment was taken at 5 o'clock.

MORNING SESSION

Thursday, Oct. 20, 1921.

President Strouse called the meeting to order at 9:40 a. m.

A delegation from New York and vicinity presented a proposed amendment to the constitution which recommended that where 10 or more members resided in the same city or geographical district the executive committee should be given power to or-

ganize a local section to which all of the members of that district would be eligible.

The proposition was not received in time to send out in proper form before the annual meeting, but the members in the vicinity of New York were given to understand that the association had no objections to the plan being tried out and if successful, to continue, without any obligation on the part of the association.

President Strouse:—As I view the situation it is merely a matter of organizing these chapters in the various sections of the country for the purpose of getting better acquainted and to talk over matters of interest pertaining to the association. It is a question in my mind whether it is advisable to make it a part of the constitution or simply to have it understood that as many as may want to form such chapters may do so.

The matter was left in the hands of the executive committee to decide what action if any should be taken at the next convention.

The secretary read the names of several members who desired to be placed on the life membership list.

The following were elected life members: D. W. Sharpe, P. J. O'Neill, G. T. Sampson, Tom Tretheway, S. B. Thorne, Hugh Bulger and M. Riney.

President Strouse:—We will now take up the selection of the location for our next convention.

F. E. Weise:—Our association is growing very rapidly and the attendance this year indicates that we will have to figure carefully on our meeting places. We had considerable difficulty this year in arranging for a hotel that could take care of us properly. Last year we had to change the date of our convention because the hotels at Atlanta could not accommodate us the week our convention was scheduled. I feel that nominations should not be made by any one unless the hotel situation has been canvassed in advance. We need 250 rooms or more either in the same hotel or in a hotel that is within a block or two of the headquarters to take care of the attendance at our convention. We must also be assured of a good meeting room where we will not be disturbed by outside noises. We have had a lot of trouble in the past, and even here, with the outside noises shut out, it has not been easy for one to hear all of the discussion. We ought also to know that the supply men can have their exhibits near the convention hall. For that reason I suggest that you do not make any nominations unless you know what the hotel situation is.

President Strouse:—We are now ready for nominations for our next meeting place.

R. H. Reid:—We should hold our annual meetings in as nearly a central, convenient and easily accessible location as possible. If we go too far away it requires too much expense and takes one away from his work at a time of the year when it is hard to spare him from his work. October is possibly the busiest time of the year. A great deal of the season's work is just being finished. We are trying to get it closed for the winter, and some of us are on our inspection work. If we take two, three or four weeks away from our work at that time it practically breaks up the entire fall. While our managements have approved of our going, they don't like to have us away so long at that time of the year. They don't say much, but I know that it makes them a little nervous to have the men in charge go far away.

The meetings of some of the associations, as some of you probably know, have been discontinued on account of the distance they have gone, the time they have been away from the work, and possibly the lack of business accomplished for the railroads. The primary purpose of our association is to promote the interests of the companies that we represent. For all of these reasons I nominate Cincinnati.

G. W. Andrews:—I take a great deal of pleasure in seconding the nomination of Cincinnati. We met in that city for what was really our first convention in 1892. The roads saw the character of work that we had commenced and gave us their undivided support. They have continued that undivided support right up to the present date, as was proven here Tuesday by the presence of Mr. Besler, and yesterday by Mr. Loree, both of whom have taken great interest in the work of this association. Knowing that, I feel especially at this time that we would make a great mistake in selecting a place anywhere beyond the Rocky Mountains, and the closer we get to the middle West, the better our managements will be satisfied.

A. Fraser:—I nominate San Francisco as our next meeting place. We have good hotels, a good chamber of commerce, and we can take good care of a convention. Many of you have been there, and we know that those of you who have not will come back singing the familiar old hymn, "The Half Was Never Told."

The nomination of San Francisco was seconded by Mr. Gentis.

J. P. Wood:—At the present time conditions are far from

normal in the railroad world. It therefore behooves the members of this association to look well to the selection of the next meeting place. When times become settled I do not think our railroad managements would say a word to our going west but I am fearful at the present time, and under existing conditions, whether they would sanction it.

E. T. Howson:—Mr. President, I think Mr. Wood has touched the keynote which should guide us in selecting our meeting place. We are not selecting a meeting place to do honor to San Francisco, Cincinnati or any other city. Our selection should be based on our cold-blooded decision as to what is best for this association. I don't believe we can afford to let our personal opinions influence us. There is not one of us who would not be glad of the opportunity to go to San Francisco. But I am going to vote for a central point because I believe it is for the best interests of this association. How many railway men can go to San Francisco, involving as it does a minimum of three weeks, and the expenditure of considerable money? There are only three associations out of probably 50 in the railroad industry that have held their conventions without interference within the last year. They have been held because they have stuck to the work at points centrally located.

I believe that a vote to go to San Francisco will be a complimentary vote only. I don't believe a man in this room would be in a position to go to this convention if their managements would send out word quietly that they shouldn't go. I believe that under the present chaotic conditions the only thing to do from the standpoint of this association is to play safe, and select a central point where the largest number of men can get to the convention with the minimum of expense and time.

Therefore, with all warmth of feeling toward the western coast, (I have many friends there, and they can show us a royal good time) I don't think the present unsettled times in the railroad conditions are any times when we should take any chances with the success of our association because it is the success of the association that we are interested in, and it is on that basis that we are going to cast our votes. (Applause.)

The vote was then taken by ballot and Cincinnati was selected by a large majority on the first ballot.

J. S. Huntoon:—One of our very eminent members, Colonel George H. Webb, is now on his deathbed. I think it would be no

more than fitting that this convention send him a message of greetings.

F. C. Baluss:—As chairman of the Committee on Resolutions, I move that the president of this association send a message of kindly greeting to Colonel Webb.

The motion was seconded by Mr. Ridgway and carried unanimously and the message was sent by President Strouse.

President Strouse:—The next order of business is the Report of the Committee on Subjects.

REPORT OF COMMITTEE ON SUBJECTS

E. T. Howson:—Your committee suggests the following subjects for consideration next year:

1. Pile driving records.
2. Labor-saving devices in routine bridge and building work.
3. Building inspection and records.
4. The relative merits of wood, steel and concrete tanks.
5. The painting of structural steel.
6. The framing of bridge timbers before treatment.
7. The handling and driving of concrete piles.
8. The construction and maintenance of sewers and drains.

The committee also suggests to the program committee that an effort be made to secure an individual paper from a proper authority on the subject of The Detection of Decay in Wood Piles of Various Timbers.

E. T. Howson,
J. S. Robinson,
Committee.

The report was adopted.

President Strouse:—The next order of business is the report of the Committee on Resolutions.

REPORT OF COMMITTEE ON RESOLUTIONS

Resolved: That the American Railway Bridge and Building Association in convention assembled deplores the present agitation for a strike of railroad workers and the individual members hereof reaffirm an unbroken record of loyalty to their respective railroads and pledge anew their support to the managements in their efforts to provide uninterrupted, efficient and economical transportation for the American public.

Further, that the thanks of the Association be extended to the following persons and corporations:

To Mayor John F. Hylan and his representative Francis P. Bent, member board of estimates for his address of welcome, extending the courtesies of the City of New York, to the Association:

To W. G. Besler, president and general manager of the Central Railroad of New Jersey for his address to the Association on behalf of the railroads:

To L. F. Loree, president of the Delaware and Hudson Company for his interesting address on the origin and development of railroads:

To the Michigan Central and the Delaware, Lackawanna and Western railroads for the special train to the convention:

To the Pullman Company for special rates and courtesies to and from the convention:

To the Pennsylvania railroad, C. K. Leiper, general superintendent; and to the New York, New Haven and Hartford railroad, J. A. Droege, general superintendent, and F. M. Clark, superintendent, for the special train over the New York City terminals:

To the Bridge and Building Supply Men's Association for the exhibits and entertainment provided:

To the management of the Hotel McAlpin for courtesies extended:

To the city press and technical journals for publishing reports of our meetings:

To the officers of the Association for their untiring efforts for the success of the convention:

To the chairmen and members of the committees for their splendid reports and especially to C. W. Wright and his committee on arrangements.

Be it further resolved that these resolutions be spread on the minutes and the secretary instructed to forward copies to all interested parties.

Respectfully submitted,

F. C. Baluss,
Robert H. Reid,
F. A. Eskridge,
Committee.

F. C. Baluss:—I move that the first resolution be sent to the Associated Press, to the Association of Railway Executives and to the American Railway Association for their information.

The motion was carried unanimously.

President Strouse:—The next order of business is the election of officers.

NOMINATIONS FOR OFFICERS

President, C. R. Knowles,
First vice president, Arthur Ridgway,
Second vice president, J. S. Robinson,
Third vice president, J. P. Wood,
Fourth vice president, C. W. Wright,
Secretary-treasurer, C. A. Lichty,
Directors for the term expiring in 1923:
F. C. Baluss,
Maro Johnson,
O. F. Dalstrom.

G. W. Andrews:—I move that Mr. Weise be authorized to cast the vote of this convention for the candidates just named.

The motion was seconded and carried.

Mr. Weise cast the ballot, and President Strouse declared the officers presented by the committee elected for the ensuing year. (Applause.)

President Strouse:—We come now to the installation of officers. Before proceeding with that portion of the order of the day, I wish to express to the membership of this Association my great appreciation for the honor that you have conferred upon me, and I want to say that I have had, I think, the same support that my predecessors have had. Much of the work was done by committees, and it was rather difficult for me, living in the extreme east to keep in touch with the various committees, but I had considerable correspondence during the year, and with the aid of our secretary, the reports were prepared and have been presented at this convention.

I will now ask Mr. Andrews, who is the oldest past president of this association, to install the officers for the ensuing year. I will ask Mr. Reid and Mr. Ridgway to conduct our new president to the rostrum. We also ask the other officers who have been elected to come forward to be installed.

G. W. Andrews:—Until last year it had been our practice simply to announce the names of the officers-elect. Last year Mr. Weise, who was then president, requested me, as the senior living past president, to install these gentlemen in a manner such that all

members present could see them and be well satisfied with the selection that had been made.

Our president-elect, Mr. Knowles, needs no personal introduction to any of you for he has been an active, consistent, reliable worker ever since he became a member of this association, and his heart and soul have been given to the cause. I feel that this association is to be congratulated on selecting such a man to preside over it for the coming year, and it, therefore, gives me a great deal of pleasure to announce the installation of Mr. Knowles as your president for the next year. I now present him with the badge of his office, the gavel, and I am sure that he will not hesitate to use it. (Applause.)

Mr. Ridgway, this association has also honored itself in electing you first vice president for the ensuing year, and I want to congratuate it and you on your accession to this important office which leads to the position in which Mr. Knowles has just been installed. I hardly think it necessary to ask if you will accept the position. I, therefore, declare Mr. Ridgway first vice president of this association for the ensuing year. (Applause.)

Mr. Robinson's face has been familiar in all of the conventions that I have ever attended, and in a number that I have been unfortunate enough to miss. I don't have to say anything to you relative to the consistent and concise manner in which Mr. Robinson has performed his various duties, and I congratulate myself, as well as the other members of the association, on having such material to choose from. I, therefore, declare Mr. Robinson second vice president of this association for the ensuing year. (Applause.)

After the bold and valiant speech that Mr. Wood made in behalf of Cincinnati, I hardly need tell you what a forceful man he is going to be when he once reaches this chair. He may not have caulked many pipes, but he has used the maul on many a piece of timber, and he can use it here and use it with force. Again I want to congratulate all of us on the accession to the office of third vice president by Mr. J. P. Wood. (Applause.)

It affords me a great deal of pleasure to be able to announce the election of an eastern man of such type and such material as Mr. Wright to the office of fourth vice president. Mr. Wright doesn't need any introduction to any of you who have attended this convention. His work in behalf of this meeting and the entertainment of the members and their ladies, has proved his value and his

worth, and has demonstrated his fitness for the position to which he has been elected. I sincerely hope that I will live long enough to see him in the president's chair. (Applause.)

The secretary-treasurer needs no introduction; I question very much if any of the members of this association would consent to his retirement from that office. I think we can safely say that he is elected for life, and it will be a very strenuous thing indeed that will ever cause us to release him from that position. I have the pleasure of announcing C. A. Lichty as secretary-treasurer. (Applause.)

But one of the three members-elect of the board of directors is present—Mr. Baluss. He comes from the road of which one of our oldest and hardest-working members, W. A. McGonagle, is now president. Mr. Baluss' work as chairman of the Committee on Resolutions would have demonstrated his fitness for the position if he had only offered one resolution—that showing the loyalty of this organization to our managements. That would have been all that was necessary to prove his value and his worth and fitness for the position and I, with more than the ordinary pleasure, introduce Mr. Baluss as one of the new members of our board of directors.

President Knowles:—I am not going to make a speech, but Mr. Andrews, Mr. Strouse and fellow members of the association, all I can say is that with your assistance, which I know I will receive, I expect to carry out a part of Mr. Andrews' expectations. (Applause.)

If there is nothing further to be considered, we will stand adjourned to meet in Cincinnati on the third Tuesday in October, 1922.

ADJOURNMENT

C. A. Lichty,
Secretary.

Reported by Estora Whitaker, Master Reporting Co., on the Stenotype.

MEMOIRS

J. M. Wilkinson

J. M. Wilkinson died at his home at Van Wert, Ohio, Jan. 29, 1921, after a lingering illness. He was born near Cleves, Hamilton Co., O., in 1848.

Mr. Wilkinson resided at Van Wert 40 years, and was superintendent of bridges and buildings of the Cincinnati Northern R. R. for 37 years, retiring in 1918, when he arrived at the pension age. He is survived by his wife and three sons: Edward, John and Clarence Wilkinson.

Mr. Wilkinson was a member of the First Methodist church, and of Van Wert lodge I. O. O. F. He joined the American Railway Bridge and Building Association at the first annual convention at Cincinnati in 1892.

Wm. A. Lydston

William Albert Lydston died at his home at Swampscott, Mass., Jan. 13, 1921, after several years' illness.

He was born at South Eliot, Maine, June 9, 1836, the son of Daniel and Elmira Freeman Lydston. For several years he was a shipwright by trade and then entered the employ of Lord and Ross, contractors at East Boston on bridge and draw construction work.

About 1880 Mr. Lydston entered the employ of the Fitchburg railroad as a bridge and building carpenter. He entered the employ of the Eastern railroad in 1882 as carpenter foreman and in 1903 was appointed acting supervisor. From 1904 to 1911 he acted in the capacity of supervisor of bridges and buildings of the Portland division of the Boston and Maine, which position he held when retired on pension on account of failing health, and was succeeded by the late B. F. Pickering.

Mr. Lydston is survived by his widow, one daughter, Mrs. S. S. French, one son, Albert W. Lydston of Swampscott, and two brothers residing at Portsmouth, N. H. Mr. and Mrs. Lydston enjoyed a happy married life of 61 years.

Mr. Lydston was a member of this association since 1903, and was made a life member in 1913.

William Ross

William Ross, yard foreman of the Chicago, Milwaukee & St. Paul railway, at Milbank, S. Dak., passed away September 11th, 1921, death being due to an acute attack of appendicitis. An operation was performed at a local hospital, but on account of his advanced age, it was unsuccessful.

Mr. Ross was born in Flodden, the Province of Quebec, Canada, October 20th, 1847, being at his death nearly 74 years of age. His early days were spent in Canada, and for several years he worked in a bridge construction crew on the Central Vermont Railway. He came west in 1879, and on July 30th of that year commenced work on the C. M. & St. P. Ry., as bridge carpenter. He was promoted to pile driver foreman in 1881, and in 1882 was appointed chief carpenter of the Hastings & Dakota and James River divisions, which position he held until 1910, when he was superannuated and given the position of yard foreman of the B. & B. material yard at Milbank.

For over forty-two years Mr. Ross served the railway company faithfully and efficiently, making a splendid record. He went through many hardships during pioneer railroading on the prairies of Minnesota and the Dakotas, but due to his sagacity and steadfastness of purpose he never found an obstacle too high to mount or a problem too great to solve. He was a man of noble character and every one who knew him will grieve his demise. He was counted a real man by all who knew him, he detested sham and hypocrisy and ever held a warm spot in his heart for the man or woman unafraid to espouse a cause regardless of whether he favored it or not. Faithful to his trust, honest to a fault, William Ross lived his days and years. He made his home in Milbank when it was first laid out and being thus so closely concerned in its development he became strongly attached to the place and its people. The funeral services were held in the church of which he was a member and he was laid to rest in the Milbank cemetery on September 15th. The immense floral tribute was mute testimony of the esteem in which he was held by his friends—he had no enemies.

Mr. Ross was a member of the Veteran Employes' Association, a life member of the American Railway Bridge and Building Association, a member of all the Masonic bodies and of the Yelduz Temple of the mystic shrine at Aberdeen, S. Dak., also a

member of the Congregational church, besides membership in various other local organizations. He always took great interest in and rendered help to these organizations as well as municipal affairs, and provided substantially for his family.

He is survived by his wife, one daughter, one son and a sister, besides more distant relatives and a host of friends.

John D. Moen

John D. Moen was born at Baraboo, Wis., April 7, 1874. He was educated in the public schools and took a two-year course in engineering at the State University of Wisconsin at Madison.

He began his railroad career in 1900 on the Chicago and Northwestern at framing Howe truss bridges at Lake City, Iowa, under Samuel Howe, the work being in charge of C. A. Lichty, as division engineer. He was married to Edna Talcott at Logan, Iowa, in 1902.

Mr. Moen worked for a number of years in the bridge and building department of the Chicago and Northwestern at Boone, Iowa, where he attained to the position of supervisor of bridges and buildings, later going with the Chicago, St. Paul, Minneapolis and Omaha in the capacity of superintendent of bridges and buildings, under H. Rettinghouse. He continued in this position until May, 1918, when he was appointed major Q. M. C., construction division, U. S. army, being mustered out Oct. 21, 1920.

He died at Bremerman Urological hospital at Chicago June 30, 1921, after a lingering illness of three months from heart trouble.

Mr. Moen joined the American Railway Bridge and Building Association at the 18th annual convention at Washington, D. C., in 1908, and took an active interest in its work.

Joseph M. Staten

Joseph M. Staten passed quietly away at his residence, 2506 Kensington Avenue, Richmond, Va., October 1st, 1921.

Born at Campbellsburg, Ky., October 13, 1851, Mr. Staten entered the railroad field when a young man of 18, his first position being with the Louisville & Nashville Railroad. He came to the Chesapeake & Ohio November 1, 1889, as the general inspector of bridges, which position he held until his death, with the exception of a short period, when he was general supervisor of bridges

on the Western division under Mr. Harry Frazier, now consulting engineer.

Mr. Staten had an important trust; he fulfilled that trust with a cheerfulness and energy that was an inspiration to all his associates. If information was wanted concerning the history of any structure he was a mine of accurate data. It seemed his peculiar pleasure, whether in good or ill health, to do his duty like a man and to smile always in the face of odds.

One of the outstanding features of Mr. Staten's long service with the Railway Company, was the suggestions he constantly made relative to the use of old material, which effected in many cases a great saving in bridge and building work.

Mr. Staten leaves, besides his widow, formerly Miss Mary Coleman, of Frankfort, Ky., one daughter, Mrs. Otis M. Greene, of Richmond, Va.

Mr. Staten joined the American Railway Bridge & Building Association, at the first annual convention, at Cincinnati, in 1892, and was one of its most active members until the time of his death.

Charles Edgar Powell

Charles Edgar Powell was born February 25, 1862, near Crozet, Va. He entered the Miller Mechanical School at Crozet at the age of 12 years, and completed the course at 18. August 31, 1880, he entered the service of the Chesapeake & Ohio Railway in a carpenter crew with Mr. I. Garrison on the Richmond division. He was promoted to carpenter foreman in 1888. He was made assistant supervisor of bridges and buildings in 1895 on the Richmond division, and in 1903 was appointed supervisor of bridges and buildings west of Clifton Forge with headquarters at Hinton, W. Va. In 1913 he was appointed general inspector of bridges from Handley, W. Va., to Chicago, including all branch lines, with headquarters at Covington, Ky., where he died July 26, 1921. Mr. Powell had not been well for a year or more but had been able to look after his work from time to time. He had just completed inspecting bridges from Cincinnati, Ohio, to Peru, Ind., on the Chicago division on Friday, July 22. On Sunday the 24th he suffered a stroke of apoplexy from which he never rallied.

He leaves a wife, Willie Catherine Via, to whom he was married December 24, 1884, at Charlottesville, Va. To this union were born six children, five of whom are living: W. M. Powell, Clifton

Forge, Va.; H. A. Powell, Richmond, Va.; Mrs. Pearl Powell Mason, Hinton, W. Va.; J. W. Powell, Covington, Ky., and Miss Lottie Powell with her mother at Covington, Ky.

The funeral was held at the residence 220 E 15th Street, Covington, Ky., July 27, with interment at Oakwood Cemetery, Charlottesville, Va., July 28, 1921. The floral offerings were many and beautiful and came from friends and men he had been associated with for years, many of whom followed him to his last resting place. Had Mr. Powell lived to August 31, 1921, he would have completed 41 years of service with the railway company.

Mr. Powell joined the American Railway Bridge and Building Association at its nineteenth annual convention at Jacksonville in 1909.

Charles W. Brown

C. W. Brown, B. & B. Foreman on the Southern Pacific Company, died Sept. 17th, 1921, after an illness of four days.

Mr. Brown was born in New Lexington, Ohio, May 9th, 1867. He served his apprenticeship in the carpenter's trade and followed this trade until his death, working as a general carpenter until 1897 when he entered the service of the Florence & Cripple Creek railroad as carpenter. He was later promoted to foreman, leaving this Company's service in 1901 to enter into business for himself in Denver, Colorado. He again entered railroad service in 1903, working as machinist and foreman for the Colorado & Southern until 1906 when he left to again enter the contracting business in Goldfield and Rawhide, Nevada.

He entered the service of the Southern Pacific Company in 1909, as bridge carpenter, being promoted to foreman in 1912, continuing in this position until his death.

Mr. Brown enjoyed to an unusual degree the confidence and respect of his superiors and of all who knew him.

He joined the Association at New Orleans, in 1916.

Robert C. Sattley

Robert C. Sattley, valuation engineer of the Chicago, Rock Island & Pacific, died suddenly of heart disease on December 31, 1920, at his home in Chicago. He was born November 26, 1856, at Ferrisburg, Vt.

Mr. Sattley graduated from the State University of Vermont, and in 1879 began his railroad career as a civil engineer with the

Northern Pacific on construction work while it was being built through Montana, Idaho and Washington. In 1885 he went with the Chicago & Northwestern, where he served nine years as assistant engineer on double track work on the Wisconsin and Galena divisions, after which he was superintendent of bridges and buildings for 11 years and division engineer two years. When he resigned his position with the Chicago & Northwestern, he became connected with valuation work with the state of Minnesota at St. Paul for about two years and was for a short time on location work in Colorado.

In 1909 Mr. Sattley became associated with the Chicago, Rock Island & Pacific as assistant engineer on valuation work and soon became in full charge of that department. He was later recognized as one of the best posted men on railroad valuation work in this country.

He is survived by his wife, two sons and three daughters. He was a member of the American Railway Engineering Association, the Western Society of Engineers and the Chicago Engineers' Club. He joined the American Railway Bridge and Building Association at its eleventh annual convention at Minneapolis in 1902.

James Stannard

(By C. W. Gooch)

James Stannard died January 7, 1921, at his home in Kansas City, Mo., following a short attack of uremic poisoning. He became connected with the Missouri Pacific in 1874 in the capacity of foreman of bridges. In 1880 he was appointed general foreman of bridges and buildings of the Lexington & Southern from Pleasant Hill to Joplin, Mo. In 1881 the division from Sedalia to Kansas City was added to his territory, with headquarters at Holden, Mo. He held this position until 1883 when he accepted the position of general superintendent of bridges and buildings of the Wabash, with headquarters at Moberly, Mo. He represented the Wabash in its interest in the exposition at St. Louis in 1904. He resigned his position with the Wabash in 1906 and returned to his home in Kansas City.

Mr. Stannard was interested in developing silver mines in Colorado in 1909 and 1910, in which he was part owner. In 1916 he purchased an extensive tract of land covered with cypress timber at Nettleton, Ark., from which he furnished the government with large quantities of railroad cross ties and lumber during the world

war and continued his activities there until a short time before his death.

He was a charter member of the American Railway Bridge and Building Association and took an active interest in the early work of the organization, serving as its sixth president, from Oct. 1896 to Oct. 1897.

He was a congenial personage—a man among men, actuated by the highest ideals, greeting all with cheery good words with whom he came in contact. Each and every one can truly say that life was made better and happier for having met him.

James Simpson Browne

Died October 22, 1921

James Simpson Browne was born on November 14, 1862, in the town of Indiana, state of Pennsylvania, the son of the Reverend Faneuil Browne, a Presbyterian clergyman. He received his early education in the schools of Indiana County and was tutored by his father in the higher branches. He entered upon his career as a civil engineer with one of the pioneer parties of the Northern Pacific Railway and was engaged in the location and construction of its line through the Dakotas, Montana and Idaho. He was later engaged in the development of the Brooklyn elevated railways and in the building of the Washington arch over the Harlem river, then the largest steel bridge span in the country. Later he joined the forces of the late George B. Francis in laying out the West Shore Railroad along the Hudson River.

Mr. Francis was engaged in 1889 by the late E. P. Dawley as resident engineer of the Providence Terminal Company, formed to design, construct and operate a union passenger station to serve the roads then entering the city of Providence and now forming parts of the New York, New Haven and Hartford Railroad System, and Mr. Francis brought Mr. Browne to Providence to assist him in that work.

When the station was completed, Mr. Browne was retained by Mr. Dawley, largely in connection with the abolition of grade crossings in Rhode Island and Massachusetts and as assistant in charge of maintenance work.

In 1903 a division office was established in Providence with Mr. Browne as division engineer. He served in that position until 1914 when he was made assistant to W. J. Backes, engineer main-

tenance of way, and moved to the headquarters of the department at New Haven, where he served until his death.

Mr. Browne was a member of the American Society of Civil Engineers, the American Railway Engineering Association and the American Railway Bridge and Building Association.

While he had a wide and varied experience in railroad location and construction, beginning his career in what was then the far west under the strenuous conditions surrounding pioneer railroad location work, and having a part in the construction of important engineering structures, he was essentially a student and preferred to pursue research work in the quiet of his office or study rather than to engage in the turmoil of the construction camp.

As assistant to the engineer maintenance of way, one of his first and most important duties was to prepare a manual for the guidance of the employes, and the present "Book of Rules" of the maintenance of way department is a monument to his devotion and loyalty. Devotion and loyalty are the very foundation of an engineer's training and as a rule are taken as a matter of course and hardly mentioned but they were so conspicuous an attribute of his character that they are the first qualities that come to the mind of his associates in the profession, who thus pay spontaneous tribute to the man.

He is survived by a widow, Mrs. Flora D. Browne, two brothers in Missouri and two brothers and a sister in Pennsylvania. He was buried in the family lot at Huntingdon, Pa.

Station and Grounds at Morristown, N. J. D. L. & W. R. R.

THE CONSTRUCTION AND MAINTENANCE OF CINDER PITS

REPORT OF COMMITTEE

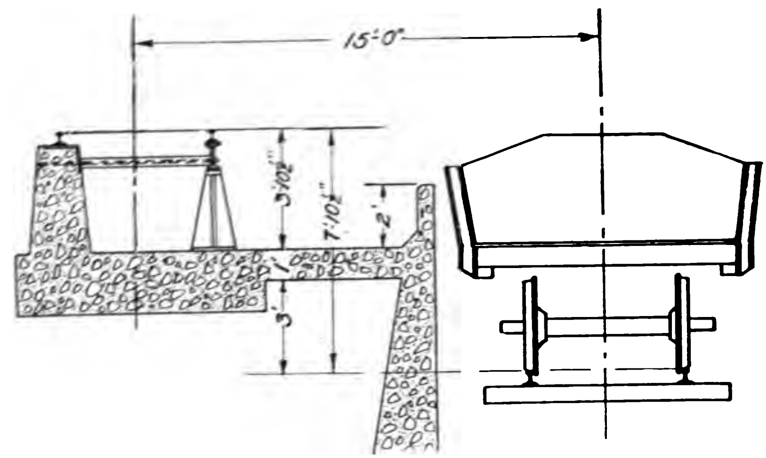
Your committee was instructed to report on the "Construction and Maintenance of Cinder Pits" on railroads in the United States and Canada. The replies received from the various roads developed the fact that many kinds of pits are in use, each road favoring its own type which is adapted to its location and climate. After the various plans submitted had all been compared it was found that there really existed only the following types of pits:

A. Depressed track pits where ashes are loaded into cars by hand.
B. Dry pits where ashes are received in cast iron buckets and loaded into cars by means of an overhead crane.
C. Water pits, both shallow and deep, where ashes are removed by clamshells operated by a locomotive or overhead crane and loaded into cars.
D. Miscellaneous pits, where ashes are removed by various mechanical means.

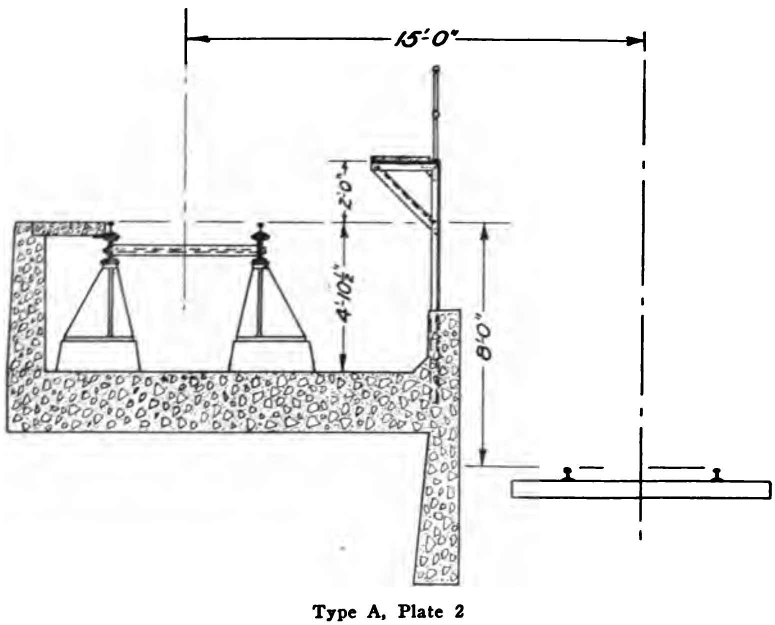
The committee has investigated the cost of construction, operation and maintenance of these various types of pits, but due to the varied locations we have not been able to get any cost data that are reliable from any of the roads. The committee feels, therefore, that this phase of the subject should be dropped and the work confined to design. It may be generally accepted that when a type of pit is selected, the selection is governed by local conditions and the cost does not entirely govern the type chosen.

Type A, Plate 1, is a standard pit used by the Duluth, Missabe and Northern at Proctor, Minn., and is a typical design of the hand-loading pits used by many of the railroads in this country. This road has two such pits in use at the above terminal, each 175 ft. long. During the ore season approximately 132 engines are handled over both pits in 24 hours. The pits are constructed with one rail resting on the back wall of concrete, the other on two 10-in. channels back to back with cover plate top and bottom, these supported by cast iron pedestals, 7-ft. centers. This pit has shown a failure in one respect: the action of the hot cinders and water on the top and face of the back wall have caused it to crumble and produce an unsafe

bearing for the rail. No trouble has been experienced with the cast iron pedestals, and with a reasonable amount of cleaning of the hot cinders away from the steel beams, they do not buckle. The beams require cleaning and painting every spring and fall. The back wall can be protected with old plates ¼-in. thick hung over the edge of the back wall on the inside of the



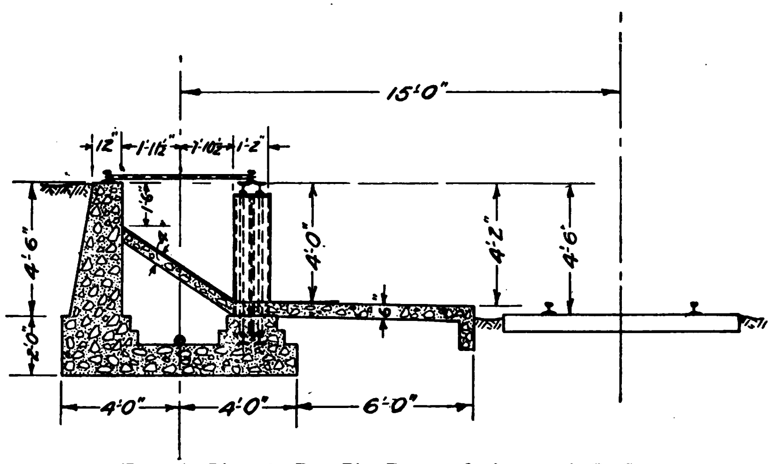
Type A, Plate 1,—Standard Cinder Pit, D. M. & N. Ry., Proctor, Minn.



Type A, Plate 2

pit and down the pit about 3 ft., leaving an air space between the cinders and the concrete. This will prolong the life of the back wall.

Type A, Plate 2, shows the pit deepened and both rails supported on cast iron pedestals with a pre-cast slab between the rail and back wall; this design keeps the rail off the concrete wall and leaves the beams and pedestals exposed where they can be replaced in a few minutes, if a failure should occur.

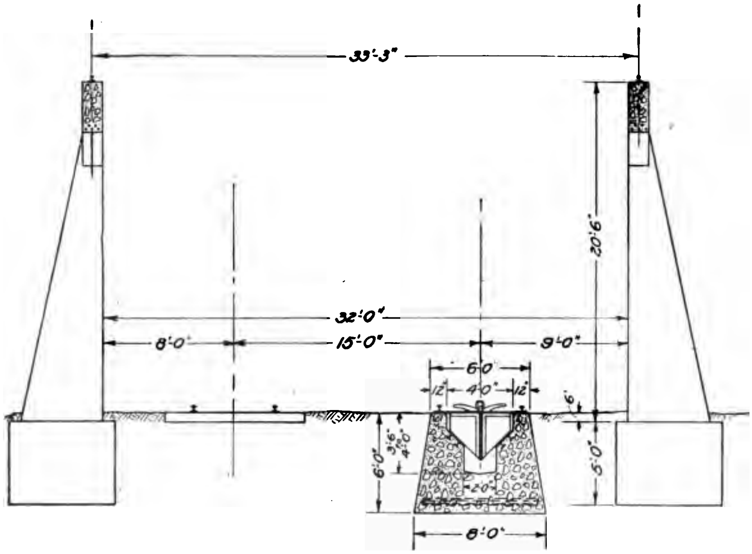


Type A, Plate 3,—Dry Pit, Bangor & Aroostook R. R.

Type A, Plate 3, shows a dry pit used by the Bangor and Aroostook, and is similar in construction to Type A, Plate 1, the difference being that the bottom of the pit slopes from the back wall to the center of the pit; the beam carrying the track is made of two 70-lb. rails placed upside down to support the track; the pedestals are spaced 6 ft. ⅜-in. between centers and are built of two 70-lb. rails back to back on end and encased in concrete, the concrete being protected by a ⅛-in. steel plate; these vertical rails are supported by two 70-lb. rails running lengthwise in the foundation.

The Buffalo, Rochester and Pittsburgh has a pit at Lincoln Park, N. Y., shown in Type B, Plate 4, which seems to be a favorite design for a dry pit in cold climates. This pit can be built with one track and a loading track, or if the length of the pit is fixed, several tracks can be built side by side. This style of pit is constructed of a series of cast steel buckets placed in shallow pits to receive ashes direct from locomotives. There is enough depth provided under the buckets to allow for drainage.

The buckets are handled by means of an overhead crane from the pit directly to the ash cars. The pits are of an unusual shape with sloping sides in the upper part and a narrow rectangular lower portion, old rails being imbedded in the sloping surfaces with their bases projecting ⅛-in. from the surface of the concrete; each parapet wall is capped with a 12-in. channel to which the track rail is bolted. The buckets have a capacity of 2 cu. yd. each, each seated on the projecting rails of the pit walls. When the buckets are filled the traveling crane carries them to the cinder cars where they are dumped automatically. The buckets open at the bottom like a clam shell, the two halves being carried by a pair of scissor levers at the middle. The Chicago, Burling-

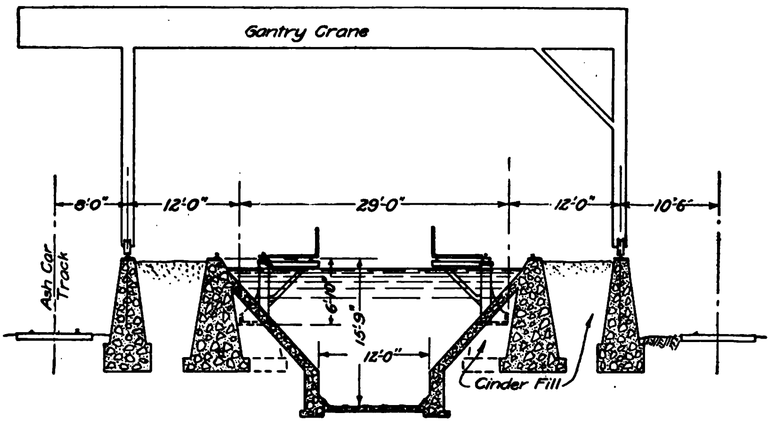


Type B, Plate 4,—Buffalo, Rochester & Pittsburgh Pit at Lincoln Park, N. Y.

ton and Quincy has developed and constructed the latest ash pit of this design at Denver, under the supervision of W. T. Krausch, building engineer.

The Lehigh Valley has two modern water ash pits, both being built within the last three years. The one at Coxton, Pa., Type C, Plate 5, is a double-track arrangement, 400 ft. long with a water pit between the two tracks. The water pit is 12 ft. wide in the clear by 14 ft. 3 in. deep, the ash tracks having 29-ft. centers. The water in the pit is generally within 1 in. of the bottom of the carrying rails, so that it is impossible to overheat or burn any part of the supporting structure. The outside rail

of each ashing track is carried on the outside concrete wall of the pit, bearing on a ½-in. iron plate. The inside rail of the ashing track is carried by three rail girders supported by heavy cast iron posts with large bases imbedded in the concrete. These carrying girders consist of two 136-lb. rails, side by side, with spacing blocks so designed that the base of the track rail, also of



Type C, Plate 5, Water Pit, Lehigh Valley R. R., Coxton, Pa.

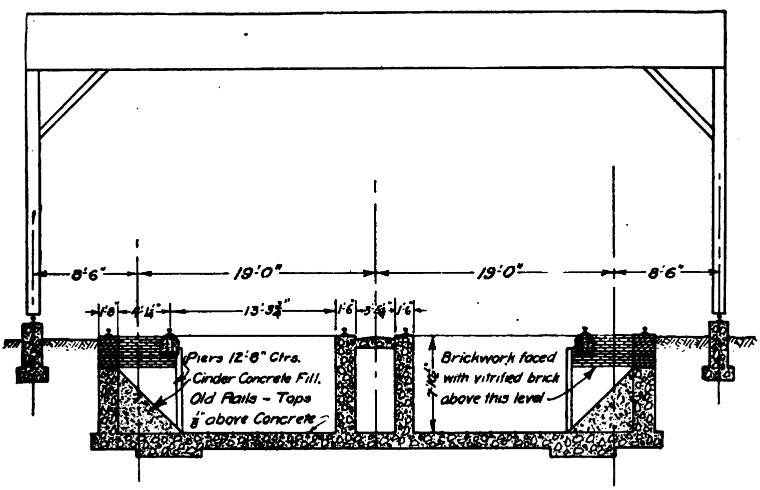
136-lb. section, rest on and are gripped between these spacing blocks and the heads of the two lower carrying rails, forming when tightly bolted together, a rigid 3-rail carrying girder.

Formerly 18-in. I-beams were used to carry the inside track rails; however, experience with them has been very unsatisfactory, as hot ashes falling upon them soon warp them out of shape, rendering them unsafe. The latest design seems ideal from every standpoint and no bad effects have been experienced from heating of the carrying rails; in fact, indications are that none will be experienced. The life, therefore, of the track supporting system under this arrangement will be many times that of the older type composed of I-beam girders.

The walks around the ashing tracks of this pit consist, on the outside, of the natural surface of a cinder fill, while on the inside the walk consists of 80-lb. rail brackets fastened to the cast iron columns. The rail brackets carry the floor of the walk, consisting of old boiler flues laid side by side and spaced by means of iron straps, so that the finer ashes fall through. A suitable railing, also of old flues, amply protects anyone from falling into the water pit.

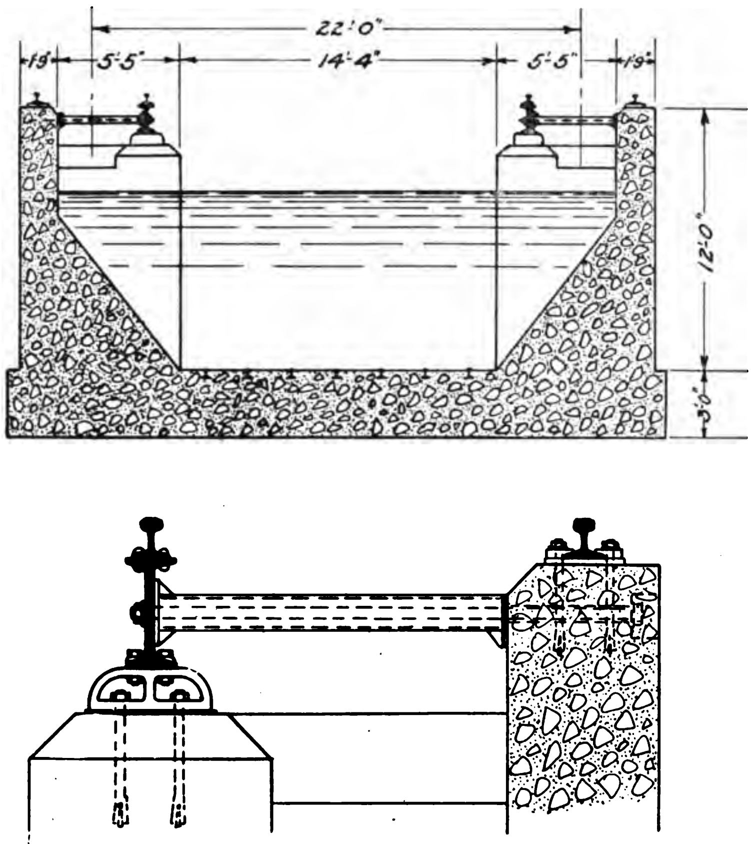
The ash car track is located on one side of the pit and the ashes are removed from the pit into the empty cars by means of a gantry crane having an overhang over the ash car track. An average of 125 engines are cleaned on this pit every 24 hours, the ashes being removed during the night in about 4 hours. This size ash pit is capable of handling at least 250 engines per 24 hours. The top of the ash pit is about 4 ft. above the yard level, thus giving good drainage. Experience has shown that when such pits are elevated from 2 to 4 ft. above the general yard level they are kept clean and neat easily and will always be free from mud, snow and ice, which are troublesome factors in yard level pits. Although the temperature in winter is considerably below the freezing point and quite often as low as 10 deg. below zero, no trouble has been experienced on this account. However, if a pit should be located in an extremely cold climate, it could be used as a dry pit, equally as well, providing sufficient attention is given to keeping very hot fires and ashes away from the carrying girders and by cooling the ashes promptly after being dropped.

Crushed slag was used, instead of stone, in the concrete for the pit as a precaution against hot cinders coming in contact

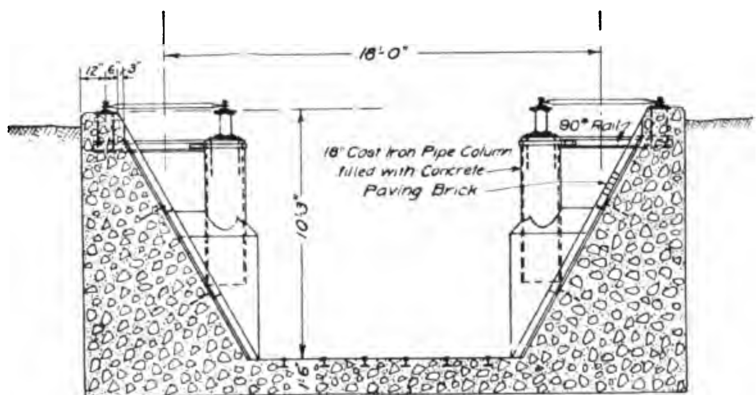


Type C, Plate 6,—Water Pit Used by L. V. R. R., and B. & O. R. R.

with the concrete while the pit is without water. The second water pit, above mentioned, is located at Ashmore, Pa., and is 341 ft. long with two water pits 11 ft. wide by 15 ft. deep. It was



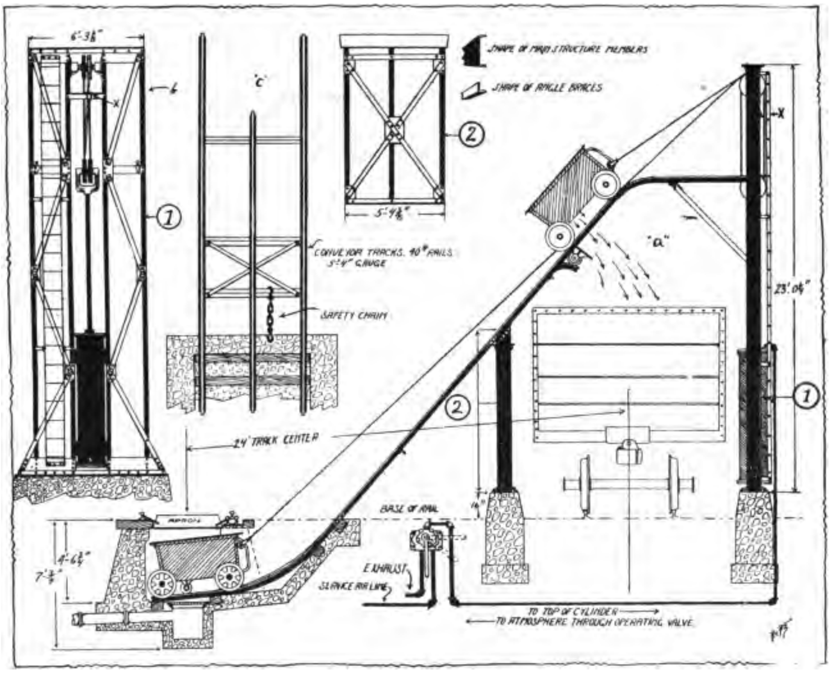
Type C, Plate 7,—Water Pit, Chicago, Milwaukee & St. Paul Ry.



Type C, Plate 8,—Water Pit, Wheeling & Lake Erie R. R.

put in service within the last 18 months. This, we believe, is the last word in ash pits but was somewhat more expensive to construct than the one at Coxton, previously described.

The Ashmore pit consists of a central ash car track flanked on both sides by a water pit. On the outside of the water pits and similarly supported over them as at Coxton, are the engine ashing tracks; the arrangement, therefore, is ideal. The gantry crane lifts the ashes out of either pit and deposits them into cars standing on the central track without the necessity of carrying



Type D, Plate 9.—Mechanically Operated Cinder Pit

them over the engine ashing tracks, thus eliminating all possible interference with engines on these tracks. The water in the pits is kept at a level of 1 in. below the rail girder track support, and the walks and railings, as at Coxton, are built of 80-lb. rail and old boiler flues. About the same number of engines is handled over this pit as at Coxton with a capacity for double the number. This pit is similar in design to Type C, Plate 6, in use on the Baltimore & Ohio.

Type C, Plate 7, shows a water pit used by the Chicago,

Milwaukee & St. Paul. This pit is operated by the use of a locomotive crane and clamshell. The 15-in., 100-lb. girder beam rests on cast iron shoes which are supported by concrete piers on 10-ft. centers. The feature of this pit is that locomotive cranes can be used for other work, except for the few hours each day which are required to empty the ash pit, thus cutting down the operating cost.

Type C, Plate 8, shows a pit used by the Wheeling & Lake Erie which is similar to that of the C. M. & St. P. except that it has a fire brick lining on the sloping sides of the pit. The rail girder is made of two 12-in. I-beams, with a 40-lb. cover plate, top and bottom, forming a box girder supported by an 18-in. cast iron pipe column filled with concrete.

Type D, Plate 9, shows a mechanically-operated pit which seems to be a favorite for small terminals and shows a low cost of operation. The Pere Marquette installed one in January, 1912, and from recent reports the pit and conveyor are in good shape with very little maintenance. This is the only road which reported the use of a mechanical pit. There are two good points in favor of the mechanically-operated pit. It requires less room, due to cinders being loaded continually into cars; and it requires but one man to operate it, which makes for a low operating cost. The structural steel in these pits should be inspected, cleaned and painted frequently.

The Robertson Cinder Conveyors Company advises that one unit of its mechanical pit will handle one engine every 20 minutes, loading cinders and leaving the pit ready for the next engine. This seems to be an ideal pit where one man runs the coal dock, pumps water and operates the cinder pit.

G. K. Nuss, Chairman.
C. L. Beeler,
Wm. Cardwell,
H. A. Gerst,
W. L. Rohbock,
F. E. Schall,
E. R. Wenner,
J. P. Wood,
A. E. Kemp,
Committee.

DISCUSSION

J. L. Pickles (D. W. & P.) :—I would like to ask whether any of the members here who handle large quantities of cinders have any trouble with the freezing of cinders. Have cars been made to carry hot cinders?

G. K. Nuss (D. M. & N.) :—I know of an iron lined car, but the wood portion burns just the same. There are also steel cars but it is difficult to keep them in shape.

A. Ridgway (D. & R. G.) :—We have in use one type of pit that the committee have mentioned which I think is becoming quite common throughout the country. It is applicable only where steam is available or where a boiler can be utilized for the purpose. Steam is conveyed to the pit through a large pipe underneath. Then the cinders are shoveled into a hopper and the steam acts as a siphon, using a larger pipe to blow the cinders away. We have one pit where the cinders are conveyed in that manner. Of course, in the mountains we have plenty of holes in which to blow them. Any hole, however, will be filled up eventually and then other disposition will have to be made, such as loading from a pile by steam shovel.

We have another arrangement in connection with that pit that blows the cinders up out of the pit, and over into a hopper-bottom car. This is for use in warm weather. The trouble with cinder pits in cold climates is the freezing. As Mr. Nuss has suggested, no car has been developed that one can load hot cinders into without damaging the car. We have tried, of course, to use the wooden cars and found we had to quench every particle of fire before the cars could safely receive the load of cinders. We have tried steel cars, but the hot cinders will warp them all out of shape. It seems that thus far the only thing to do is to quench the cinders thoroughly and we have found nothing with which to put fire out except water so far. This conveyor to which I referred soon wears out the inside of the pipe but it is so arranged that the nozzles and parts subject to wear are easily renewable. Our pit has been in service somewhere from 12 to 18 months, and is quite satisfactory but we still have the same problem to contend with—the freezing of the wet cinders in winter.

G. K. Nuss :—The committee found a pit similar to that on the

Chicago & Northwestern in Milwaukee. The experience there was that there was continual wear on the ends of the tubes where the cinders were delivered into the ash cars.

E. L. Sinclair (C. M. & St. P) :—We have one of those deep pits referred to by Mr. Nuss where we have ample room for storage close to the pit and our plan has been to store the cinders in the winter and load them out with a steam shovel in the summer. We made some investigation and some designs for a plan of storing, but never carried it out. I would like to ask Mr. Nuss if he knows of any place where they have made arrangements for storing cinders in winter and loading them in summer.

G. K. Nuss :—No, I do not know of any such place, but I think it could be arranged where there is ample room to store them until spring.

J. L. Pickles :—We have such an arrangement with a mechanical hoist. We have the air hoist type which becomes inoperative in cold weather, so we store the cinders along the track and load them out with a ditcher in the summer. We are now contemplating installing a raised track and dumping the cinders under this raised track in the winter and loading them out during the summer.

J. S. Robinson (C. & N. W.) :—We have an arrangement of that kind at our Chicago shops where we store cinders both summer and winter. We have use for them on branch lines as ballast. We have 60,000 cu. yds. stored there now that we may begin to load out at any time. We accumulate about eight cars a day at this point. We have four points in Chicago with pits 320 ft. long where we clean the fires from 75 engines and also give them water during the noon hour. We ship these cinders in regular cinder cars, loading them with clamshells and locomotive cranes, and unloading from the cars with a clamshell.

A. Anderson (L. S. & I.) :—We always store cinders in the winter time. Up in our country we consider they are valuable as ballast and we do not want to waste them. They are hard to handle in the winter time. When spring comes, we load them out by the aid of a locomotive crane.

A. M. Swenson (Soo Line) :—On our road cinders are accumulated on a track in the yard which is elevated by the section crews as necessary, spreading the cinders as the track is raised.

L. D. Hadwen (C. M. & St. P.) :—I would like to ask if some of the members will give their experiences with water pits with reference to the question of damage to the upper portions of the

pits from burning by hot cinders. When we first constructed this type of pit, the water outlet was not high enough to keep the upper portion of the concrete track support submerged, and there was quite a little space below the rail girders and the top of the water. The result was more or less damage to the concrete by heat from cinders that were allowed to pile up above the water level. That has been remedied by raising the level of the water in the pits.

There is another feature about these water pits; pressure must be brought to bear on the operating department to keep the cinders removed; and the locomotive crane must not be diverted to other work, allowing the cinders to pile up round the concrete pedestals and sides above the water level and freeze in winter. The trouble is that a locomotive crane is a mobile piece of equipment and is liable to be diverted to other emergency work, leaving the pit without proper cleaning facilities and allowing an undue accumulation of cinders.

We have used a steam conveyor, but it was found very extravagant in steam consumption. I would like to ask Mr. Ridgway if he has had that same experience and whether he finds it economical to use a steam conveyor.

A. Ridgway:—Of course, you are using some steam with a two or four inch pipe. In almost all cases you have to make provision for extra power when you are operating a pit of that kind for it does use a lot of steam.

J. S. Robinson:—Someone spoke of not having to cover the cast iron pedestals with anything. We have covered them with concrete and sometimes an old piece of boiler plate over the concrete, and along the sides of our pits. We have to put cast iron plates on to keep the concrete from chipping or wearing off with the heat. I would like to ask Mr. Hadwen if he has designed any concrete girders to take the place of the I-beams.

L. D. Hadwen:—We have not used concrete in those pits.

R. H. Helick (P. R. R.):—We built a concrete pit, reinforced with concrete girders, and I do not like it at all. Unless the water is kept up around the concrete, it burns out, and our trouble is to keep the water high enough. We had an overflow pipe which we had to plug up to keep the water high enough. It seems to me that the burning out of the concrete would be dangerous after a while.

We have a type of pit that has not been mentioned here. It is a development of the old pit which had a bucket running on a

track in the bottom. We found that that pit was not able to handle the number of engines desired so we made a wet pit of it. We rebuilt it, relined it with vitrified brick back of the concrete and put a cast iron coping on top and we find it gives very good satisfaction although it has been in service only a couple of years. Vitrified brick is used because it does not absorb the water. The only trouble with it is that in time it may spawl off and burn out, in which case I do not think we will have any trouble in relining.

A. B. Scowden:—We have experimented with protecting steel I-beams in wet pits with concrete but have not had very satisfactory results up to the present time. I would like to inquire if anybody has tried the same thing.

J. P. Wood (P. M.):—We tried the scheme of protecting the I-beams with concrete but it was a failure.

R. H. Reid:—We have some pits on the New York Central which I think have not been included in the report. One is a pit about 10 in. deep which is used along the line where engines are cleaned on the way. One of these is located at Rockport near Cleveland which is not a terminal but where trains frequently stop. The rails are carried on castings resting on concrete and below the bottom of these castings a couple of rails are embedded in the concrete so the cinders can be loaded with a clamshell bucket if desired. These are all right where fires are cleaned and where a large pit is not required.

At some terminals we have short pits with rails on the walls, some being as short as 20 ft. and from 3 to 3½ ft. deep. Cinders are shoveled from these by hand.

We have other pits where one rail rests on the wall and the other side opens to a depressed platform from which cinders are shoveled by hand into cars on a depressed track, the sides of the cars being the height of the platform. The side walls of these cinder pits are of slag concrete, having a fire-brick face and heavy cast iron shoulders. It is well known that where cinders are left to burn after being dumped in such pits the cast iron pedestals and I-beam girders become burned and warped and have to be replaced. This of course is the result of negligence.

We have some wet pits similar to those shown in the report. Our latest type of pit has a rail carried on the wall on one side and the opposite rail rests on a 105 lb. inverted rail which is set down in the cast iron posts 12 to 13 in. deep and 8 in. wide and fastened at each post by clips and flanges. The supporting

rails can not tip and will stand a great deal of heat before they will fail.

We have some pits with 3-rail sections, that is, two supporting rails with little cast iron blocks between them on which the running rail rests. We have experienced a great deal of trouble with these as the constant grinding of the cinders wears the blocks and bottom flanges of the girder rails and the little bolts wear off, rust off and burn off. Owing to the failure of these we adopted the scheme of having two rails described above with only 5-ft. spans, as it is a very simple arrangement and nothing to get out of order.

We also have some pits with 9-in. I-beam girders where castings rest on the bottom flanges of the girders and the running rails rest down between the I-beams with the head of the running rail high enough above the top of the beam so that a wheel flange will not rest directly on the top of the I-beam. We have had the same trouble with these that was experienced with the 3-rail girders, for the bolts rust and wear off and the castings and flanges of the beams wear off letting the rails down so the flanges of the wheels run on the beams.

E. R. Wenner:—We have a pit at Coxton, Pennsylvania, that has now been in service three years with no less than 125 engines over it every 24 hours. I made a close examination of it about a week ago and found that it has not shown any wear at all, although I have found it at pits of similar designs on other roads where they have not kept up the bolts. When you let the bolts get away from you the space between the carrying rails is drawn up tighter. I feel safe in saying that without any question our pit will go for the next 10 years if it stands the rate it is going now and if the bolts are kept tight. The water level in this pit is maintained within 1 in. of the carrying rail.

T. B. Turnbull (A. A.):—We have two or three dry pits where the three rail sections are carried on posts on 5-ft. centers. I do not know but we may have secured our plan from the New York Central. We renew these dry pits every 4 or 5 years. We have to renew the two lower rails of this girder on account of the hot cinders. These pits are left without attention over night so that the hot cinders accumulate and burn the flanges so they are just like knife blades, and then the packing block cuts down necessitating renewals.

G. K. Nuss:—I would like to answer Mr. Robinson in regard to the cast iron pedestal. We have found that a failure always

occurs at some time. We have also found it a good plan to keep several I-beams on hand where the cast iron pedestals are free. It is only an hour's job to change them. That is the way we handle the dry pits and we have better success that way than any other.

J. L. Pickles:—The amount of heat wasted in these pits must be apparent to everyone. I do not think it would be much trouble to design some way to heat our buildings with it. That would be better than to dissipate it in the way we are doing. I would like to suggest that our committee on subjects see if we can utilize this heat that is being wasted and help save this fuel we are so anxious to save.

Martin's Creek Viaduct, D. L. & W. R. R. East of Kingsley, Pa. (Showing old line underneath). Consisting of seven 150-ft. segmental arch spans; two 100-ft. semi-circular arch spans and two 50-ft. semi-circular arch spans. Total length, 1611 ft. for 3 tracks. Height above creek, 150 ft. Deepest pier, 100 ft. from ground line to rock.

CONSTRUCTION AND MAINTENANCE OF PASSENGER PLATFORMS

REPORT OF COMMITTEE

This association has never before made a thorough study of passenger platforms. They have been mentioned frequently in past proceedings but always in connection with station buildings. The subject is one that is worthy of special thought and study, particularly from a maintenance standpoint. The first report made to this association in which platforms are mentioned was presented in 1893 and it is of interest to note that at that time wooden platforms were almost universally used while they are now disappearing rapidly and are in danger of becoming obsolete. It is also interesting to note what is replacing them.

When a new platform is to be built or an old one replaced the first problem is to determine the kind of platform to be used. There are many kinds to choose from, including concrete, brick, asphalt or mastic, asphalt blocks, wood, crushed stone, gravel, cinders, chats, etc. The selection for a particular location depends upon the kind and volume of traffic, climatic conditions, availability and cost of materials, importance of the station for passenger traffic, permanence, probability of future change of grade and whether under cover or exposed to the elements. While most platforms may become slippery in freezing weather, those with a perfectly smooth and hard surface become slippery much more readily than others and for that reason alone some types of platforms that are perfectly satisfactory in southern localities are not suitable in areas where there is much freezing weather. Baggage and express handlers complain that when working on hard and smooth platforms the trucks move too easily while standing at express and baggage car doors. At the same time platforms with a very rough surface are objectionable when heavy loads must be trucked over them.

The kind of platform finally decided upon depends upon the following factors: 1, traffic; 2, service life; 3, availability of material; 4, appearance; 5, cost, and 6, the relationship of these factors to the location.

The following table of the frictional resistances of various surfaces is of interest and may be of use in making decisions where heavy trucking is necessary:

Brick, smooth	Resistance	40	lbs.	per	ton
Cement floor	"	40	"	"	"
Granite blocks	"	56	"	"	"
Wood blocks	"	40	"	"	"
Gravel roads	"	75	"	"	"
Clay roads	"	200	"	"	"
Poor concrete	"	53	"	"	"
Wood planking	"	43	"	"	"
Wood planking, sticky surface	"	57	"	"	"

Traffic

Probably the most important factor influencing the type of platform to be built is the volume and the kind of traffic. In this connection it may be noted that the use of trucks with iron wheels taxes the platform surface the most. At some stations, the stopping of trains can be so controlled that heavy trucking can be confined to a limited portion of the platform. Where such a practice is possible, this portion may be built to withstand heavy trucking, while the remainder which is used only by foot passengers may be of less expensive construction.

Service Life

The service life of a platform is dependent upon the material forming the wearing surface, the foundation supporting this wearing surface, and the use that is made of it. It is closely allied to the kind and volume of traffic and the two must be considered jointly.

Availability of Material

This factor is one which has much to do with the decision because the cost of transportation adds much to the cost of a structure, and most platforms are built of materials that can be secured nearby. Thus we find that in a timber country, wooden platforms predominate, in a clay country brick platforms, in the vicinity of lead and zinc mines, platforms of chats, near the seaboard, shell, etc.

Appearance

There is no portion of a railway property that is more in the public eye than the passenger platform. It is walked over by hundreds of people going to and from trains and is subject to close scrutiny while passengers are waiting for trains. For this reason the platform has a certain advertising value which should not be overlooked. A good looking, clean, sanitary and attractive platform cannot fail to make a good impression upon the

traveling public and this impression is emphasized if when looking from the car windows, station after station presents the same attractive appearance. This does not mean that all platforms need be of the same kind but they should all be kept in good condition.

Cost

While the cost of a platform is often the deciding factor, it should be considered in relation to the other factors and particularly to the service, life and cost of maintenance. As with all other railroad structures a well built platform that requires a minimum maintenance expenditure will warrant an increased first cost. It is the object of this report to present facts that will be of assistance in deciding what is best to use.

Filled Platforms

For convenience the committee uses the term "Filled Platforms" to designate those that are made with a top surface of cinders, gravel, stone screenings, shells, chats or other suitable material which is merely compacted by tamping or rolling. These are built both with and without curb.

There are some locations, especially at wayside stations, where there is no trucking and at which a filled platform without curb can be used. Something will depend upon the ground surface and the drainage, but usually a platform of this kind, if carefully built to begin with, will give very satisfactory service with very little maintenance expense for many years. Bad spots will develop from time to time, especially in wet weather, but they are easily repaired. As a rule platforms of cinders or stone screenings are objectionable when much trucking is done, especially in the spring of the year when the frost comes out, when they are also objectionable because of the dirt that is tracked into stations and coaches by passengers.

The usual method of constructing these platforms is to excavate to a level grade about a foot below the base of rail, put in a six-inch layer of broken stone or cinders and on this six or eight inches of screenings, shell, chats or other finishing material. This is thoroughly rolled or tamped, making a hard, smooth surface.

F. A. Eskridge advises that on the Chicago and Eastern Illinois it is the practice to install screenings platforms at the smaller cities and country stations, which are usually constructed of a

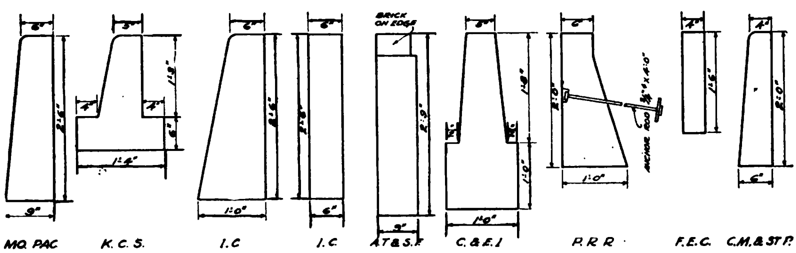
six-inch cinder or broken stone base and six to eight inches of screenings, well tamped. Concrete curbs are used with these platforms. This type of platform is considered the cheapest and most satisfactory form of construction for small stations. Mr. Eskridge reports that platforms of this type have been in service on this road for 12 years with no maintenance cost to date.

D. G. Tewksbury reports that gravel and chats are used on the Missouri Pacific for platforms at small stations where trucking is light. This road is also using what is called chip rock. A layer of about 4 in. of chip rock is placed on a cinder foundation with a rock dust topping. This material packs and becomes fairly solid and is more satisfactory than either chats or gravel. It withstands moderate trucking successfully.

J. J. Taylor reports that at the less important stations the Kansas City Southern builds an earthen platform capped with six inches of oyster shells, held in place by a retaining wall of second-hand stringers on edge on the back side and in front of the depot. This makes a very economical and satisfactory platform.

Curbs

Most platforms of this kind are built with a curb of wood, stone or concrete. Sometimes this curb is placed only on the side opposite the track, at other times on the track side, and again on all sides. The curbs used vary considerably in design but in



A STUDY OF CONCRETE CURBS

Fig. I.

the main are much like those used in connection with brick and concrete platforms. Figure I shows the different types of concrete curbs and their usual dimensions. This illustration not only shows the different ideas of various men but also brings out the varying needs of different localities. This curbing is usually made in 6-ft. lengths at some shop or supply yard and is then shipped to the job. Fig. II shows the precast concrete

curb and post used by the Long Island Railroad. This drawing was submitted by C. W. Wright who states that it is favorite form on that road and has many advantages.

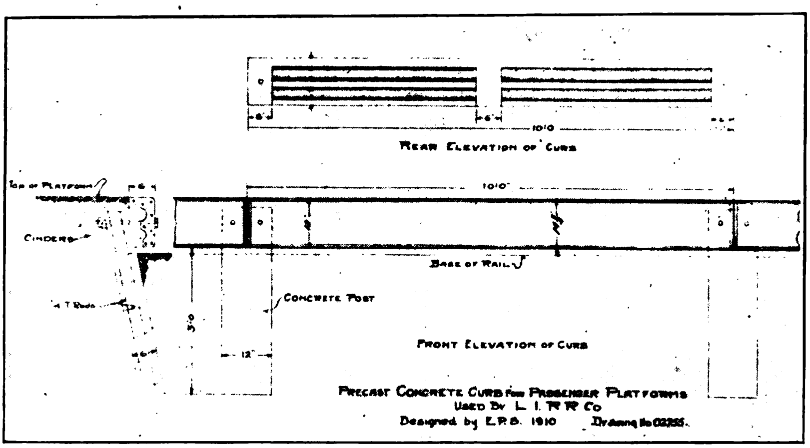


Fig. II. Precast Concrete Curb—Long Island R. R.

Coal Tar Concrete

In a report made to this Association in 1901 mention is made of the construction of platforms of what was called coal tar concrete. It was cheaply built, the average cost at that time being stated as 7½ cents per square foot, and it was claimed to have a life of about 13 years. This platform is so named because the top dressing consists of a mixture of coal tar and sand. If built in summer 60 gal. of coal tar is used with one cubic yard of sand, while in cold weather the proportion of coal tar is increased from 20 to 30 per cent. The report indicated that this style of platform had been used quite extensively by the Boston and Maine and the committee thought it might be interesting to ascertain if this road was still using them. An inquiry to A. I. Gauthier, supervisor of bridges and buildings, brought the following reply:

"I have looked up my old proceedings and found J. P. Snow's specifications for coal tar concrete, which are the same as we are using now, although we have not installed any new tar concrete platforms for a long time. We have a large number of these platforms on the Boston & Maine and when they are installed properly, on a good cinder or gravel foundation, well drained,

they give excellent service. They will last 10 or 12 years, at the end of which time they become somewhat rough in places, necessitating repairs or the renewal of the top coating. When this style of platform is installed properly it gives good satisfaction and will last indefinitely by renewing the finishing coat periodically. When these platforms were first installed very little attention was given to proper drainage. In some locations drainage was not necessary as the nature of the ground was such as to take care of any water which might be at hand. In other locations, drainage should have been provided but was not, with the result that the tar concrete platform heaved and became so bad that it had to be removed. In cases of this kind, we have not relaid them for financial reasons, but have installed stone dust and cinders which are not very satisfactory, especially where heavy trucking is done."

As copies of the 1901 proceedings are scarce we reprint herewith the specifications for coal tar concrete platforms prepared by J. P. Snow, who was at that time bridge engineer of the Boston & Maine.

> "The platform will be paved with coal tar concrete. It shall be at least four inches thick after being thoroughly rolled, and must be put down in the best manner. The ground shall be well compacted before the concrete material is put on. The first or lower course of stone shall be not less than one inch in diameter and the second course not more than one inch, both of these courses to be well covered with tar before laying, and thoroughly rolled. The finishing course shall be not less than ¾-in. in thickness after it is rolled, and shall be composed of good, clean, sharp gravel, well dried, heated hot, and mixed with half pitch and half tar. This course shall be well rolled and all edges well tamped and smoothed with proper tools. The roller prescribed above shall weigh not less than 700 lbs. on a length of not more than 22 ins. Curbstones will be required on the track side only. On other sides the concrete will be rolled down and stopped in the ground. A curb must be used on the side next to the rail. It is not necessary on other sides unless at stations where teams back up to the platform. Our rule is to set the face of the curb 2 ft. 6 in. from the outside of the rail head, with the top level with the top of rail, and in country stations to finish the ends and back side with a depressed edge without a curb. Old fashioned gas tar should be used. Tar from retorts where water gas is made is useless, and many of the quick-process, gas-burning ovens produce very poor tar."

Wooden Platforms

As stated before, wooden platforms were almost universally used about 30 years ago while they are now disappearing rapidly except in localities where timber is plentiful and cheap. Some roads report that they discontinued their use some years ago and have none now, others that they are still in use, but their number is growing less each year. The cost of lumber has made the wood platform comparatively more expensive in recent years and has led to the use of other materials from which a longer service life can be expected.

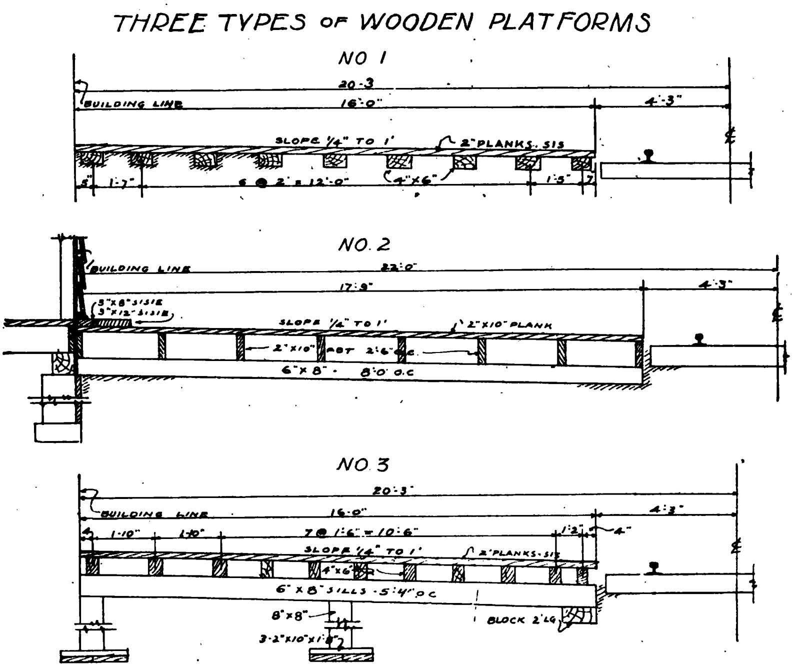


Fig. III. Three Types of Wooden Platforms

In localities where wooden platforms are still used it is found that there has been no change in practice in recent years. Old standards are still in effect. Fig. III shows cross-sections of the usual types, three in number. The first shows plank laid on sleepers resting on the ground and is usually employed in dry localities or for temporary installations. The life of such a platform is rather short, varying from 3 to 5 years, and is usually only warranted to take care of a temporary need. In this class may also be included what is known as pontoon walks or plat-

forms such as were sometimes used at military camps during the war. The second drawing shows plank laid on joists that rest on sleepers embedded in the ground. This platform gives somewhat better service because there is an air space under the floor for ventilation, which keeps the floor and joists comparatively dry. The sleepers in this style of platform rot quickly and it might be worth while to make them of treated timber. The third plan shows the flooring and joists resting on stringers which in turn are supported on blocking or posts. This form of wood platform gives the best service, lasting from eight to ten years. Instead of wood posts, more permanent supports of brick or stone can be used.

The floor of wood platforms soon shows the wear of trucks and traffic and it is not long before it becomes uneven. It is rather difficult to keep a wood platform in good appearance. Broken or worn plank replaced by new look bad and are apt to form stumbling blocks for passengers. This is one of the main objections to the wood platform.

The committee did not learn of any installations of wood block passenger platforms although there is no reason why they should not be used for this purpose.

Concrete Platforms

It was rather surprising to the committee that concrete is not used more generally for station platforms. Concrete sidewalks are almost universally used in towns and cities and mile upon mile of concrete highway is being built with good results. A station platform is subject to more severe use than sidewalks or highways because of the use of trucks with iron wheels and the need frequently of handling heavy freight over them in addition to baggage and express. In some cases it is not long before the edges and corners begin to chip and crack and small imperfections start in large surfaces. In colder climates they are liable to injury by frost. Then too platforms adjoin railroad tracks and are subject to marked vibrations from passing trains.

There are many instances of concrete platform installations that are giving excellent service although as a general rule they are more successful in warmer climates. As has been brought out frequently in our reports and discussions there is no form of construction that requires more care and skill than the application of concrete, and it will be found that many imperfections

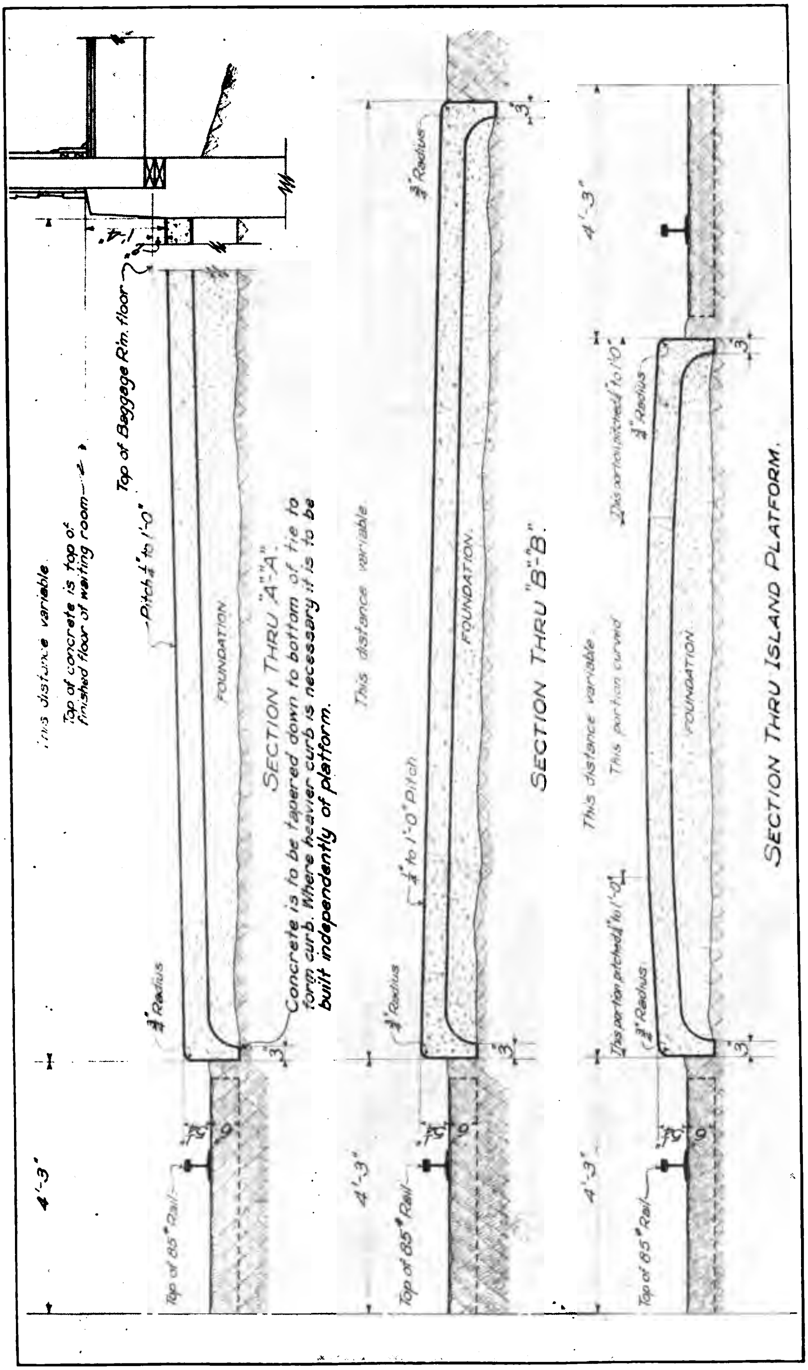


Fig. IV. Cross-Sections of Concrete Platforms, C. M. & St. P. R. R.

can be traced directly to some error or lack of care in workmanship. One trouble with the concrete platform is the difficulty of making repairs. For this reason it is apt to be allowed to stay in an unsightly condition for a long time before it is considered bad enough to require renewal. In case of a change of grade a concrete platform cannot be raised or lowered but must be broken up and a new one put down.

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The following specifications are those of the C. M. & St. P. and indicate the usual practice in concrete platform construction. See Fig. IV for cross-sections to accompany these specifications.

SPECIFICATIONS FOR ~~CONSTRUCTION OF~~ CONCRETE STATION PLATFORMS

~~Chicago, Milwaukee & St. Paul Railway~~

FOUNDATIONS:—Where subsoil is of soft material, it must be thoroughly rammed before the filling forming the sub-base of the platform is placed. The filling is to be of gravel or cinders from six to ten inches thick, depending on the nature of the soil and its liability to heave. If cinders are used containing head end cinders, sufficient sand or gravel should be added to make them bond well. The sub-base must have good drainage. The filling must be thoroughly rammed, using water where available and when completed, should be firm but porous. The surface must be wet down thoroughly before concrete is placed.

CONCRETE:—Wherever possible, preference is to be given to one course construction, making the concrete five inches thick and obtaining the wearing surface without adding a special mortar top coat, for such one course construction, the proportions used are to be one of cement to two of sand and four of crushed stone or coarse aggregate. Where the available gravel or crushed stone is so coarse as to necessitate the use of a separate mortar wearing surface, this is to be made of a one to one mortar, and the placing of this top coat must follow up the concreting of the base promptly and not more than thirty minutes be permitted between the two operations. The consistency of concrete for platform work must not be sloppy but stiff enough to avoid separation of the aggregate and avoid checking which is more apt to occur if the concrete is too wet.

SURFACE:—The surface shall be struck off with a straight edge and finished with a float to a rough float finish, avoiding excessive troweling which causes flaking of the mortar skin. In no case shall the surface be troweled smooth enough to be slippery.

THICKNESS:—Ordinary platforms are to be five inches in thickness. At more important stations where traffic is very heavy, make platform six inches thick on such parts of it as are subjected to heavy trucking, especially in front of baggage room doors and at points usually opposite baggage car doors.

ROAD CROSSINGS:—Where there are driveways across platforms, such crossings must be made not less than eight inches thick and the edges sloped well into the ground to prevent breaking or chipping by vehicle wheels and are to be grooved lengthways. Where sidewalks connect with platforms there should be no abrupt change of elevation.

CURB:—Ordinarily only a light curb will be built by spading back the earth down to the bottom of the tie so as to present a concrete face

on the track side below the forms. The outside faces of the curb must be thoroughly and carefully faced to insure an impervious surface; this requirement must be given close attention.

Where a heavier curb is required, it must be built independently of the platform and carried down to a satisfactory foundation below sub-grade, if necessary.

REINFORCING:—Where platforms are built adjacent to recently raised track under heavy traffic, reinforcing, either bars or mesh, should be used, imbedded two inches below the surface and having cross sectional area of .06 sq. in. per lineal foot of platform at right angles and parallel to the track. Reinforcing must not extend across expansion joints.

SLOPE:—Platforms are to be built with a pitch of ¼ in. to the foot, the top of platform adjacent to the track being made level with the top of rail. Platforms are to slope from depot buildings to the track but beyond the buildings will slope away from the track; the transformation from the upward slope of the platform in front of the depot to the downward slope of the platform beyond the depot must extend over a sufficient distance to prevent the warped surface being noticeable. Island platforms are to be crowned with a vertical curve in the middle tangential to the standard slopes to the tracks on either side.

JOINTS:—Platforms are to be marked off into squares with not less than five foot sides, nor greater than eight foot sides, to suit the dimensions of the platforms. Joints are to be made about each block by cutting entirely through the concrete with a trowel. Dividing plates can be used to mark off the blocks, the joints left by their removal being filled with sand. The grooving tool used for marking must have smallest radius possible to avoid rounding the edges at the joints which will wear under trucking. Expansion joints ⅜ in. wide at right angles to the track are to be provided every fifty ft. These joints are to be made by the use of special expansion joint boards ⅜ in. by 5 in. which are to be built into

Fig. V. Concrete Passenger Platform, Santa Barbara, Cal., Southern Pacific Co.

the platform so that concrete will come squarely against the boards, avoiding rounding corners.

PROTECTION:—Platforms should be kept moist and protected from traffic for at least two days after the concrete is placed.

GRADE OF TRACKS:—In every case before building a concrete station platform, it should be ascertained whether or not a ballast raise is to be made and, if so, steps be taken to bring up the track to final grade before work is commenced on the platform.

G. W. Rear of the Southern Pacific sends in a photograph of a concrete platform at Santa Barbara, California, Fig. V, which is very attractive in appearance and is giving excellent service. There is no frost at Santa Barbara but the road has some concrete platforms in Oregon where there is frost and zero weather at times which platforms are giving good results. The Southern Pacific has only a few concrete platforms and none in very severe climates. Mr. Rear's statement as to methods is best given in his own words:

"We have no standard plans or specifications but we believe the most important feature is the surface. We are bitterly opposed to laying platforms with a base and a wearing surface applied to the base either before or after the base concrete has taken its initial set. We insist on the floor or platform being run altogether and the surface made out of the concrete itself.

We mix the concrete in 1:2:4 proportions, just wet enough to work well. It is then placed and struck off with a straight edge. As soon as it sets a little, the surface is floated and then troweled smooth and marked. A little dry cement is used when the surface is floated. The accompanying photograph, Fig. VI, shows how a cross-section of such concrete looks. In order to demonstrate to our supervisors just how to do the work, we made a sample about 4 feet square and had it sawed into 6 inch cubes and polished on one side of each cube. Each supervisor was furnished with one of these cubes. Such platforms stand trucking without damage and do not break at the edges. Expansion joints should be placed at frequent intervals. We leave one inch space at about 50-foot intervals and fill the space with asphalt. Before using this method we had some trouble from expansion. Our previous method had been to insert two thicknesses of tarred paper at the expansion joints, but when the weather got warm we had some trouble. This can probably be explained by the fact that the concrete was placed at about 65 to 70 degrees temperature. It never gets below 40

degrees but does get as high as 110 degrees on the platform surface, (probably higher). Reinforcement is not required where the foundation is suitable."

The C. & E. I. finds concrete to be the most satisfactory material for passenger platforms in large terminals and in larger

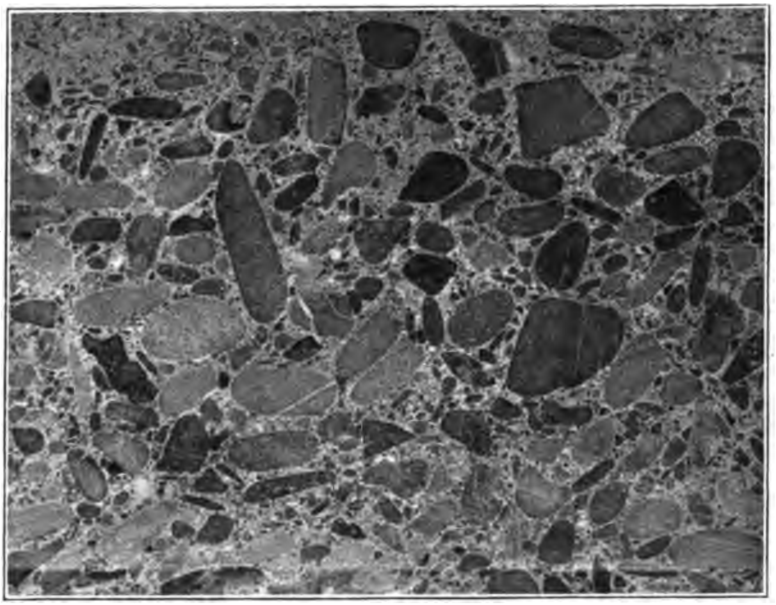

Fig. VI. Cross-Section of Concrete for Platforms—Southern Pacific Co.

cities where the traffic is heavy. From the standpoint of construction and maintenance this road has found platforms built to the following specifications the most economical.

"Excavate to a depth of 10 or 12 in. and put in a layer of 6 to 8 in. of cinders thoroughly tamped. (Care should be taken to see that the subgrade has proper drainage). On the cinders lay the usual two course sidewalk, the first course of 1:3:6 and the top or finish course of 1:2 concrete. Provide expansion joints of ½-in. every 50 feet using an elastic saturated asphaltic felt. Platforms constructed according to the above specifications have been in service from 2 to 20 years without any maintenance expense. All concrete platforms are provided with expansion joints at the curb."

Brick Platforms

102 Communications from many members of the association indicate that the brick platform is finding much favor and has many points to commend it. If a brick platform develops bad spots, part of the bricks are easily taken up, the foundation repaired and the brick replaced. If the grade is changed the brick can also be taken up and relaid with no loss of material If bricks become broken they are easily replaced.

Specifications of the Illinois Central are quoted and outline, with little variation, the usual practice.

1. PLATFORM. The platform shall consist of a cinder base, sand cushion and vitrified block wearing surface.

2. GRADING. The site shall be graded from curb to curb, to the proper subgrade to permit of the specified thickness of paving materials being laid to bring the finished surface of the pavement to the lines and grades as established by the engineer.

The bottom of the excavation or top of the fill when completed shall be known as the sub-grade and shall be at all places parallel to and 10¼ in. below the finished surface of the platform.

3. SUB-GRADE. The sub-grade shall be brought to a firm unyielding surface by rolling with a roller weighing not less(than 500 lbs., and which shall weigh not less than 20 lbs. per linear inch, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroughly tamped with a hand tamper weighing not less than 50 lbs., the face of which shall not exceed 100 sq. in.

All soft, spongy, or yielding spots, and all vegetable or perishable matter shall be entirely removed from the sub-grade and the space refilled with suitable material.

In all cases where a fill is required to bring the sub-grade to the required elevation it shall be made with gravel, coarse sand or cinders in layers not to exceed 12 in. in thickness, and each layer shall be thoroughly rolled or tamped.

When considered necessary or of assistance in producing a compact solid surface, the sub-grade before being rolled shall be thoroughly sprinkled with water.

The price bid per square yard of paving must include all cost of bringing the sub-grade to its proper position and compaction and securing the same from settlement.

4. DISPOSALS OF MATERIALS. The excavated material shall be loaded by the contractor into cars which will be furnished and placed by the railroad company, or disposed of as otherwise directed by the railroad company.

5. CONCRETE CURB. Concrete curb shall be built in the location and to the elevation and sizes as shown.

The curb shall be made of concrete formed by mixing one part of Portland cement, with two parts of clean, sharp sand, to this mixture shall be added four parts of crushed stone or gravel whose greatest dimension shall not be more than ¾ in. and whose least dimension shall not be less than ¼ in. Sufficient water to wet the mass shall then be added and the whole thoroughly mixed. The mixture shall be placed in forms immediately and rammed until a film of moisture appears on top. The forms shall remain in place at least 48 hours after the mixture is placed therein.

The curb shall be covered with a finishing coat of ½ in. in thickness

which shall be applied to the face of the form in advance of the concrete and incorporated with it as the concrete is rammed in place. The finishing coat shall be a mortar composed of one part of Portland cement thoroughly mixed with one and one-half parts of finely crushed stone.

The contractor shall take precaution to protect all concrete from freezing. He shall be solely responsible for frozen concrete and shall remove and replace at his own expense any concrete damaged by freezing.

The curb shall be built in alternate sections six feet long excepting where otherwise shown on the plan. Two layers of building felt shall be placed in each joint and three additional layers in each fifth joint.

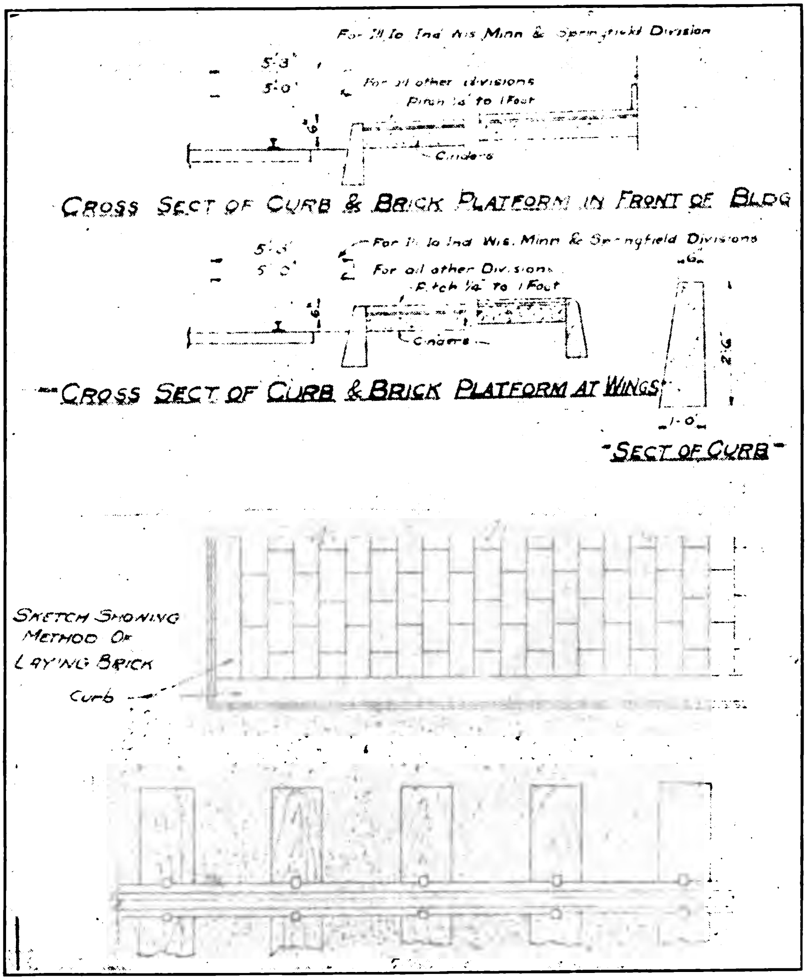

Fig. VII. Cross-Sections of Brick Platform and Curb—Illinois Central R. R.

Fig. VIII. Method of Laying Brick—Illinois Central R. R.

6. STONE CURB. The material shall be that known as Bedford Olithic limestone, even and uniform in color, free from spall holes, seams, sand holes or other defects that would materially impair its strength, durability or appearance.

This curbing is all to be fresh faced, sawed work on front and back and be reasonably free from saw blade marks for at least one foot down its front face. It shall be 5 in. thick and 30 in. in width with minimum length of 4 ft. and 6 ft. as a maximum. Its bottom to be spalled off to a line and tooled square to front and back, its ends cut full to the square with arrises sharp, and end joints vertical extending to the back of the stone.

The top of the curb shall be tooled or sawed true and smooth, its top back edge shall be square and clean cut while its top front edge shall be worked true to a radius of one inch.

All stone curbing shall be handled from cars carefully, great care being taken not to break any of its edges either round or square.

Curbing shall be set in true lines with even flush joints on a tamped compact earth foundation after which the back filling shall be put in place carefully and solidly.

Where found necessary to cut stone closures the work shall be neatly executed. At external angles or corners of platform the one inch radius on the edge of the curb is to be continued across its end to form return. To form internal angles cut curb to form a vertical lock joint with miter to form intersection of one inch radius edges.

7. CINDER BASE. On the sub-grade prepared as specified heretofore shall be placed clean fire box cinders to a depth of six inches after compacting. They shall be thoroughly puddled and rolled or tamped.

8. SAND CUSHION. On the above described cinder base shall be placed a layer of sand, free from loam and dirt, which shall be one inch in thickness when compacted.

9. BRICK. Upon the sand cushion shall be set the paving brick. They shall be best quality, hard burned, vitrified paving brick and shall be thoroughly annealed, tough and durable, regular in size, and shall be evenly burned. When broken, the brick shall show a dense and stone-like body, uniform in color inside free from lumps of uncrushed clay, lime, air pockets, cracks or marked laminations. Kiln marks or surface cracks must not exceed $\frac{3}{16}$ in. in depth.

The dimensions of the brick shall be the same throughout the entire work, and shall be not less than 8 in. in length, 4 in. in depth, and $3\frac{1}{4}$ in. in thickness.

10. TEST. The brick shall be subject to the test for loss by abrasion, as required by the City of Chicago specifications for paving brick, and the contractor shall furnish and deliver, without extra cost to the railroad company, such sample brick for testing as it may select.

11. COST OF BRICK. It shall be assumed that the above specified brick will cost $45 per thousand, and if the cost is more or less than this, allowance shall be made for the difference by the railroad company or the contractor.

12. LAYING BRICK. The brick shall be laid flat, close together in straight lines across the platform, and at right angles to the curbs. The joints shall be broken by a lap of not less than three inches.

Brickwork shall finish close against building, piers, curbs, etc.

The brick, when set, shall be thoroughly rolled with a roller of such weight and size as above specified, or solidly rammed to a true surface under a plank of two-inch material.

13. FILLING JOINTS. After brick have been thoroughly rolled or rammed, all joints shall be filled by sweeping into them clean, dry screened mason sand, and at completion of work a $\frac{3}{8}$ in. thickness of the same quality sand shall be spread and left over the entire surface of the platform.

Fig. IX. Brick Passenger Platform, Centralia, Ill., Illinois Central R. R.

Fig. IX shows a typical Illinois Central brick passenger platform built at Centralia, Illinois.

The curb and the brick laid adjoining the curb seem to be more or less troublesome. Instances are reported in which the curb has tipped outward as though too much crown had been allowed and this in flattening out had crowded out the curb. The only remedy suggested is careful placing of the curb and thoroughly tamping of the earth on each side or increasing the thickness and depth of the curb. Some also report cases in which the brick next to the curb has settled below the level of the curb, indicating that the earth next to the curb settles more than that farther away. It may also be that where a roller is used it is not easy to compact the earth next to the curb thoroughly. To overcome this trouble it is usual to lay the brick from ½-in. to 1 in. above the top of the curb.

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The curb is usually of concrete as shown in the cuts accompanying the specifications, but some roads use cut stone.

On the Atchison, Topeka and Santa Fe a different style of curb is used which has proven very satisfactory. It is built as shown in Fig. X with a concrete base topped with a row of paving brick laid on edge in cement mortar and called a rowlock.

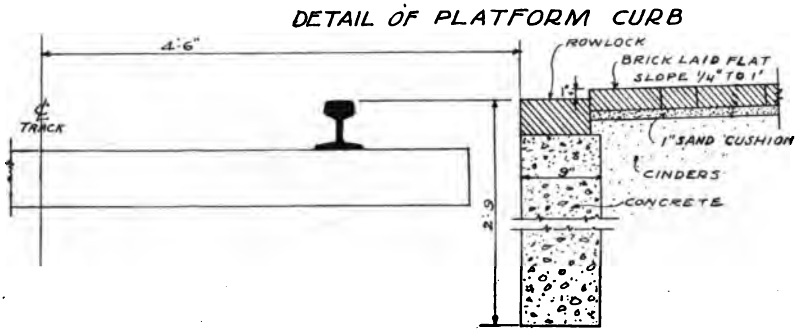


Fig. X. Cross-Section of Platform Curb, A. T. & S. F. Ry.

This form of curb was used in Blackwell, Okla., Fig. XI and is neat and attractive in appearance. It is standing up well. This form of curb has a decided advantage in case of a change in grade. If the raise is only an inch or two the rowlock is removed, a bed of cement mortar is added and the brick replaced. If the raise is more than the width of a brick an additional rowlock is placed on the old one. This is all done without disturbing the concrete base. The curb for low platforms is at the level of the top of rail, and 4 ft. 6 in. from the center of the track. The

Fig. XI. Brick Passenger Platform, Blackwell, Okla.—A. T. & S. F. Ry.

curb wall including the 4-in. rowlock on top is usually 2 ft. 6 in. deep, but in the far west, where frost does not need to be considered, it is reduced to 1 ft. 6 in. depth.

On the Santa Fe the brick for platforms are laid flat, with name down on a 1 in. sand cushion, over a rolled sand and cinder fill. The starting line of brick is placed one inch above the rowlock curbing to allow for settlement.

J. H. Markley writes very favorably of his experience with brick platforms on the T. P. & W. and estimates their service life at from 50 to 75 years. On this road the concrete curb is built in place, the mixture used being 1 part of cement to 2 of gravel and 3 of sand. The front curb is always 8 in. thick and is carried from 8 to 12 in. below the bottom of the tie; the balance of the curb is 6 in. unless it sticks above the ground 2 ft. or more. In such cases the thickness is increased sufficiently to sustain the pressure and if necessary some light reinforcing is added. Ordinarily no reinforcing is used except on the corners. Up to about 3 years ago this road used a 6 in. curb all around but it was found that the platform would settle more or less at the places where the baggage and express trucks would stand while being loaded and unloaded and the curb would be crowded out at the top. Since using the 8 in. curb no such trouble has been experienced. He reports no trouble at all from frost heaving either platform or curb and says that drainage is provided for very carefully before putting in the platform.

Asphalt Blocks

The investigation made by the committee indicates that the use of asphalt blocks for passenger platforms has so far been quite limited although their application as a general flooring material has shown a steady increase during the past five or ten years. Previous to this time, the asphalt block manufacturers apparently confined their efforts to street and highway pavements.

The limited use of compressed asphalt blocks for passenger platforms is probably due to the fact that it is only in the past two years that the manufacturers have made any intensive effort to interest the railroads in their product. However, the large and successful usage of these asphalt paving blocks in shops, freighthouses and piers for a long period of years would indi-

cate that this material is worthy of consideration in connection with future passenger platform installations.

Last year, the Association made a report on freighthouse floors, wherein the use of asphalt blocks was discussed quite fully. All that was said of asphalt blocks in this instance will apply equally to their use in passenger platform work. A brief review of this portion of last year's report will place the matter clearly before us.

Asphalt blocks are usually laid in or rather on a stiff half-inch mortar bed which has been struck to a smooth surface over the concrete base. The whole operation is very simple and no expansion joints or tar filler are used. The blocks are very uniform and lay up tight and smooth without buckling, no matter what the temperature may be. As pointed out last year, this seems to be the clean, sure, easy way of handling asphalt and maintenance costs are reduced to a minimum. The blocks are made for heavy service and the wear is very slight. No chipping or spawling will occur and a life of over 30 years is claimed by the producers.

The blocks produce a clean, comfortable non-slip surface that is dustless and practically noiseless. They are acid, alkali and water proof and the normal dripping of oil incidental to daily usage is beneficial to the asphalt blocks and readily assimilated without making a spotty looking platform.

It will be recalled that last year's report made mention of the use of asphalt blocks on the upper level passenger platforms as well as the freight and baggage platforms of the new union station at Indianapolis, Indiana. The report stated that the work at that time was in excellent condition and was apparently good for the life of the structure. An inquiry was sent to T. R. Ratcliff, engineer maintenance of way and he gives the following information in reply:

"In the new trainshed recently constructed at Indianapolis, three platforms, 16½ ft. by 1110 ft. were constructed with a concrete surface and three platforms 16½ ft. by 1110 ft. and one platform about 12 ft. by 600 ft. were constructed of asphalt block. In addition to this, asphalt block was used on the floors of the truck ways around the baggage and express elevators and so far we have no complaint to make of the service rendered. In fact, these platforms have been giving better service than the platforms constructed with concrete surface. See Fig. XII.

Fig. XII. Asphalt Block Passenger Platform in Union Depot, Indianapolis, Ind.

It was our intention when this work was begun to build all passenger platforms with a concrete surface, but one of these platforms was constructed and placed in service a considerable period ahead of the others and it was evident before the last three platforms were constructed that we should, if possible, obtain a better material for the surface.

In my investigation which followed, I visited the sugar warehouse of Arbuckle Company in Brooklyn, where asphalt blocks had been installed which I was told had been in service for about seven years. They were in very good condition and apparently would give good service for many years to come. This influenced us to use asphalt block at the Indianapolis train-shed for the platforms then unconstructed. All blocks used were 5 in. by 12 in. by 2 in. thick, laid on a sand cushion.

The trucking over these platforms has not caused the blocks to flow together so as to obliterate the joints between them. However, there are places where these joints are becoming very narrow. We have never had an occasion to take up any portion of this work after it had been laid.

The asphalt block platforms were more expensive to construct than the concrete platforms. This increased expense was

due in part to the fact that we had to lay the blocks with union brick layers in order to avoid labor troubles while the work was in progress. I do not think the appearance of the asphalt platforms is nearly so good as the concrete platform but I believe they will have a much longer life and the maintenance cost will be much less."

Owing to the slightly higher cost of heavy two-inch asphalt blocks over some of the other materials formerly used, several of the engineers and architects on the larger systems have given considerable thought to the matter of a thinner and more malleable asphalt block that might, in some instances, be laid directly on a floated cement base without the use of a mortar bed. The experience of the United States Government as well as some of our large industrial concerns in the use of an asphalt block 1¼ in. thick seems to indicate that this size block would meet our requirements.

Asphalt or Mastic Platforms

The reports received show that passenger platforms of asphalt or mastic are not very generally used and are largely confined to the larger cities and terminals. This is perhaps due to the fact that this class of work is seldom handled by bridge and building forces but is usually let to some contractor who makes it a specialty. The asphalt coating is about two inches in thickness and is placed on a concrete foundation. Much experience is necessary in building such a platform to make sure that this top coat will not become too soft in hot weather. As the asphalt coating is hard and smooth it is apt to become slippery in freezing weather. Most asphalt or mastic platforms are built under shelter as for instance in large train sheds which protect them from excessive heat.

Repairs to this form of platform are not easily made. Bad spots develop and gradually increase in size the same as in street pavements, making it necessary to tear up a portion of the top D4 coating and put in a patch. The best patches are made with heated materials and it is usually necessary to call in the contractor who built the platform to make the repairs. There is also a cold patch process but it does not usually result in as satisfactory a job as the hot process.

Passenger platforms are so closely allied to pavements and floors for handling freight that we may gather much good in-

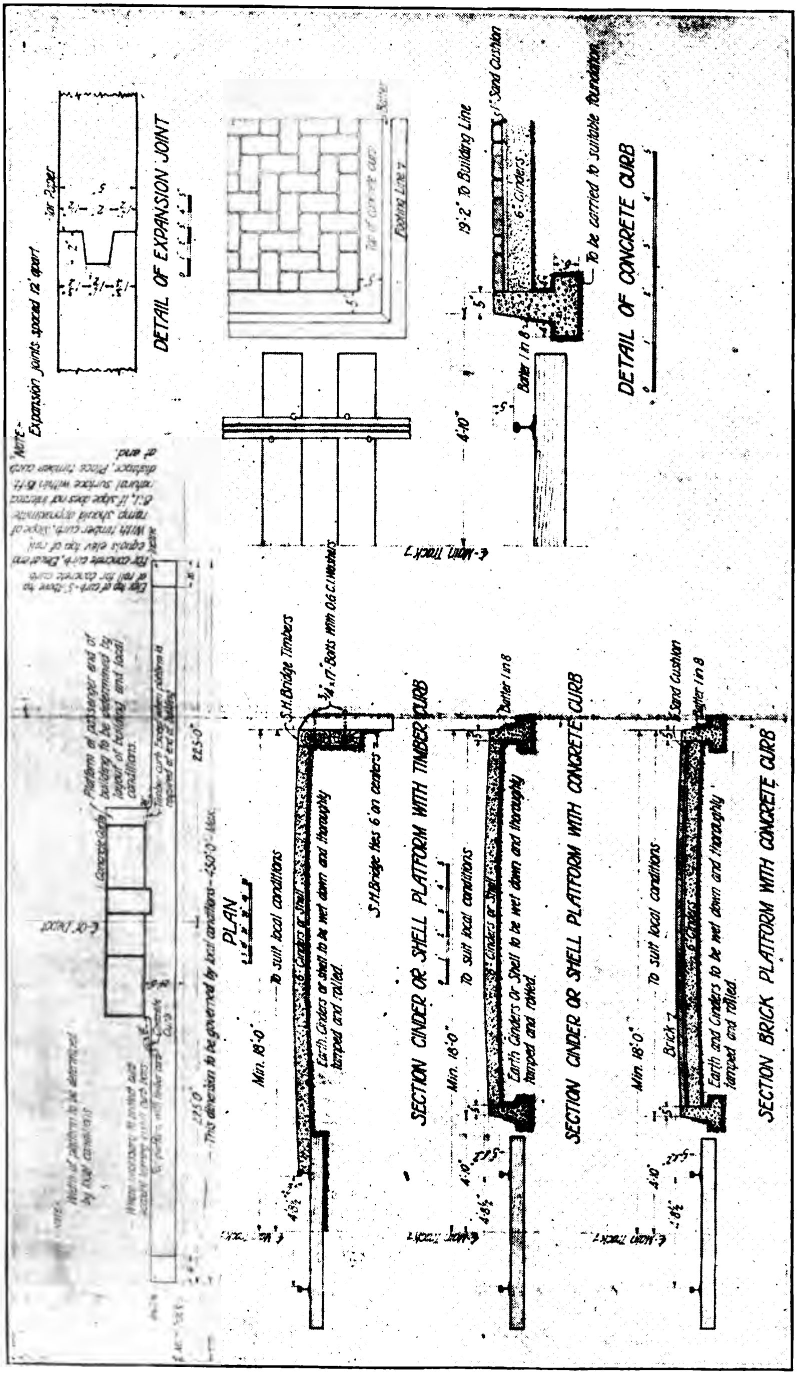


Fig. XIII. Standard Depot Platforms—K. C. S. Ry.

formation from this source. In July, 1917 the Railway Maintenance Engineer published an interesting article regarding a wharf owned by the Southern Pacific at San Pedro, Calif., on which a new asphalt surface had been placed over old worn

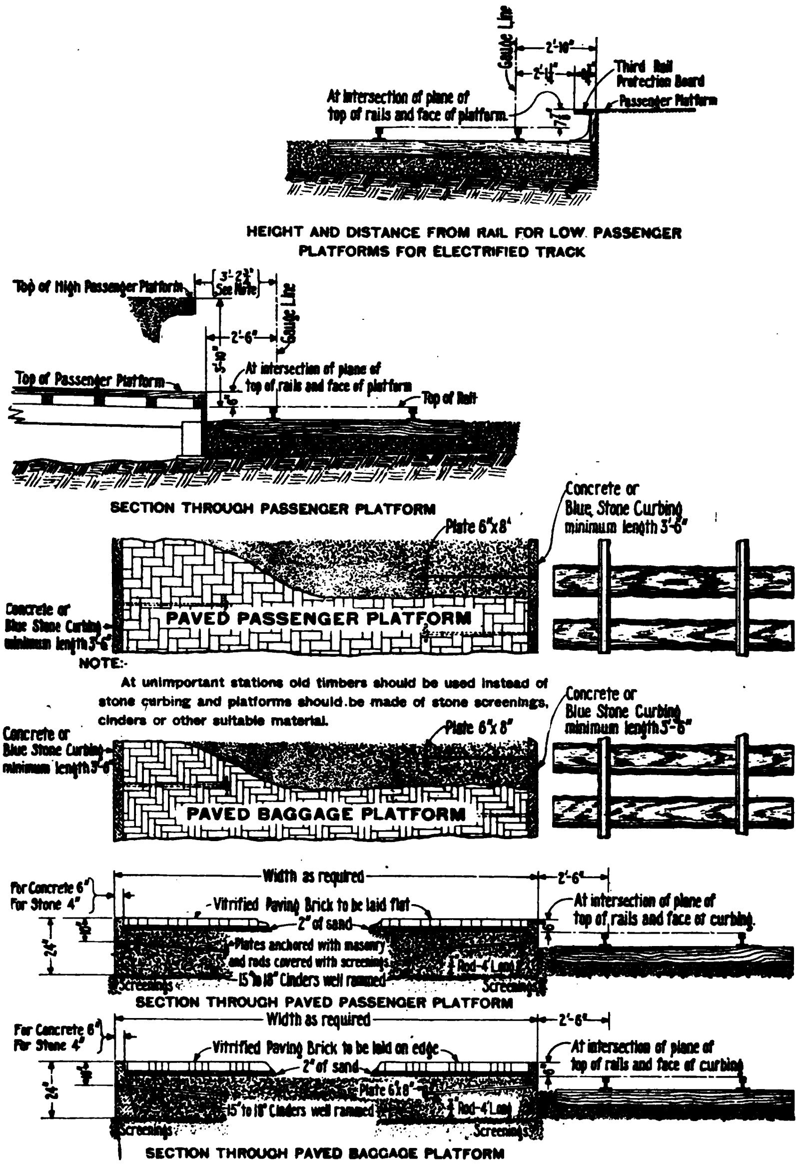


Fig. XIV. Standard Platforms, Pennsylvania Railroad

wooden decking that would have required renewal in a short time on account of truck wear. This proved very successful.

This asphalt concrete consisted of asphaltic cement, stone dust, sand, screenings and broken stone, mixed in proportions that would give the greatest density, the proportions used being shown in the table below:

Asphaltic cement	6 to 9 per cent
Stone dust	4 to 8 per cent
Sand	16 to 24 per cent
Screenings	16 to 24 per cent
Crushed rock, ¾ in. size	36 to 56 per cent
Average	100 per cent

These materials were combined in a rotary mixer after all the ingredients had been heated to temperatures carrying from 250 to 325 deg. F., care being taken that the asphaltic cement should never exceed the higher temperature.

The resultant mixture was spread over the floor with hot tools to a sufficient depth to give a pavement 3 in. thick after the rolling had been completed. A 2½ ton roller was used until the paving material had attained a consistency that would permit of the use of a 5-ton roller. The latter continued the rolling until the pavement ceased to show any marking as the roller passed over it. Portions of the pavement inaccessible to the rollers were tamped by hand.

Special pains were taken to secure good materials. Rock that was free from clay or soft, flat pieces was screened to pass a ¾-in. screen and be retained on a ½-in. screen. The screenings were material of the same kind that passed a ½-in. screen, with particles of as nearly uniform variation as possible. The stone dust consisted of material all of which would pass a 50 mesh screen and 60 per cent of which would go through a 200 mesh screen. Solid refined California asphalt was specified for the preparation of the asphaltic cement. The use of a 2-in. thickness in place of 3 in. was discussed at the time that these floors were being laid, but owing to the fact that the wharfs are subjected to very heavy truck loads of lumber it was considered that better results would be obtained with the application of a 3-in. thickness.

F. E. Weise, Chairman,
E. K. Barrett, Vice Chairman,
E. E. Allard,
A. O. Cunningham,
F. A. Eskridge,
J. H. Markley,
H. Sillcox,
F. J. Welch,
J. J. Wishart,
Committee.

APPENDIX

H. Sillcox submits the following costs of passenger platforms on the Pennsylvania System, based on 1921 prices of material and labor:

Vitrified Brick Block Platform

Specifications—6 in. concrete base, 2 in. sand cushion, 2 in. by 24 in. bluestone headers and curb with tie rods placed 3 ft. 6 in. centers.

Cost of 3 ft. 6 in. section of 12 ft. platform			Sq. ft.
2 cu. yds. excavation and disposal @	$ 2.00	$ 4.00	
7/9 cu. yds. concrete in place......	20.00	15.55	
1/4 cu. yds. sand cushion...........	3.00	.75	
200 vitrified blocks in place........	80.00	16.00	
1 tie rod in place..................	2.00	2.00	
7 lin. ft. curb in place.............	1.50	10.50	
		$48.80	
10% contingencies and overhead.....		4.88	
		$53.68	$ 1.24

Vitrified Brick Block Platform

Specifications—18 in. cinder base, 2 in. sand cushion, 2 in. by 24 in. bluestone headers and curb with tie rods placed 3 ft. 6 in. centers.

Cost of 3 ft. 6 in. section of 12 ft. platform			Sq. ft.
3 cu. yds. excavation and disposal @	$ 2.00	$ 6.00	
2-1/2 cu. yds. cinders in place......	2.00	5.00	
1/4 cu. yds. sand cushion..........	3.00	.75	
200 vitrified blocks in place......	80.00	16.00	
1 tie rod in place..................	2.00	2.00	
7 lin. ft. curb in place.............	1.50	10.50	
		$40.25	
10% contingencies and overhead.....		4.03	
		$44.28	$1.054

Cinder Platform

Specifications—18 in. cinders, curb 6 in. x 12 in. yellow pine, second hand, bolted to 7 in. x 9 in. creosoted oak posts 4 ft. 6 in. deep placed 4 foot centers.

Cost of 1 ft. section of 12 ft. platform			Sq. ft.
1 cu. yd. excavation and disposal @	$ 2.00	$ 2.00	
0.7 cu. yd. cinders in place........	2.00	1.40	
2 lin. ft. curb in place..............	.37	.74	
		$ 4.14	
10% contingencies and overhead.....		.41	
		$ 4.55	$ 0.38

Granolithic Platform

Specifications—1 in. finish, 4 in. concrete, 18 in. cinders and concrete curb.

Cost of 1 ft. section of 12 ft. platform			Sq. ft.
1 cu. yd. excavation and disposal @	$ 2.00	$ 2.00	
1 cu. yd. cinders in place..........	2.00	2.00	
1/4 cu. yd. concrete in place......	20.00	5.00	

2 lin. ft. concrete curb...........	1.00	2.00	
12 sq. ft. 1 in. finish.............	.15	1.80	
		$12.80	
10% contingencies and overhead.....		1.28	
		$14.08	$ 1.17

Screenings Platform

Specifications—6 in. screenings, 18 in. cinders and wood curb.

Cost of 1 ft. section of 12 ft. platform			Sq. ft.
1 cu. yd. excavation and disposal @	$ 2.00	$ 2.00	
1 cu. yd. cinders in place..........	2.00	2.00	
0.22 cu. yd. screenings in place....	3.25	.77	
2 lin. ft. curb in place...........	.37	.74	
		$ 5.51	
10% contingencies and overhead.....		.55	
		$ 6.06	$0.505

Wooden Platform

Specification—2 in. x 5 in. yellow pine decking S3S; 4 in. x 6 in. yellow pine nailers; 6 in. x 8 in. yellow pine sills; 6 in. x 8 in. yellow pine posts on stone blocking.

Cost of 4 ft. section of 12 ft. platform			Sq. ft.
Preparation of site................		$ 4.00	
64 ft. B. M. 6 in. x 8 in. yellow pine @	$102.00	$ 6.53	
56 ft. B. M. 4 in. x 6 in. yellow pine	102.00	5.71	
90 ft. B. M. 2 in. x 6 in. yellow pine	112.50	10.12	
2 stone blocks....................	1.00	2.00	
		$28.36	
10% contingencies and overhead.....		2.84	
		$31.20	$ 0.65

Concrete Platform

Specification—5 in. concrete, 18 in. cinders, concrete headers and curb.

Cost of 1 ft. section of 12 ft. platform.			Sq. ft.
1 cu. yd. excavation and disposal @	$ 2.00	$ 2.00	
1 cu. yd. cinders in place..........	2.00	2.00	
0.2 cu. yd. concrete in place......	20.00	4.00	
12 sq. ft. finish....................	.05	.60	
2 lin. ft. curb.....................	1.00	2.00	
		$10.60	
10% contingencies and overhead.....		1.06	
		$11.66	$ 0.97

DISCUSSION

Wood

F. E. Weise (C. M. & St. P.) :—Some roads are using many platforms built of wood and we would like to know the reason for it. The committee found little change from the methods in practice 20 to 30 years ago in the construction and maintenance of timber platforms.

G. W. Andrews (B. & O.) :—The Baltimore and Ohio still has many miles of wooden platforms in use. While those at the important stations are being replaced with brick, having concrete curbs, many of those at minor stations, especially on branch lines, are bein rebuilt with wood. We have some wooden platforms on the Philadelphia division which were built under my personal supervision as far back as 1886, and much of the covering, many of the joists and some of the sleepers put in in 1886 are still in use and giving good service. The quality of the material that was placed in those platforms cannot be obtained today. We had on hand at that time about 3,000,000 ft. of prime long leaf Georgia yellow pine purchased for car stock. About that time they changed the length of the cars and the sills and intermediates were too short so we sawed them up for platform material. Some of this has been replaced in recent years with yellow pine but inspection proves conclusively that the character of the material supposed to be of the same class is vastly inferior to that purchased at the time mentioned, and for several years later.

J. J. Wishart (N. Y. N. H. & H.) :—No wooden or granolithic platforms are being built on the New York, New Haven and Hartford at the present time because of the high cost of material and labor, except at places where it is necessary to build a wooden platform over a trestle. Our platforms are constructed with an underlay which is used for a mudsill, using old 8 in. by 8 in. or 8 in. by 10 in. bridge ties. On this we lay 3 in. by 8 in. hard pine stringers in multiples of 8 ft. with a 2-in. top. Our standard height for platforms, at the present time is 4 in. above top of rail and the edge 2 ft. 4 in. from the gage of rail. We have some wooden platforms with granite curbing. We install drain pipe under platforms in wet places. We have experienced no trouble from frost with any of our platforms because we use about 6 in. of cinders for a cushion.

E. K. Barrett (F. E. C.) :—Wooden platforms on the Florida

East Coast are usually built by using old 12 in. by 12 in. cypress timbers or creosoted pile butts for posts. On these are placed 6 in. by 6 in. by 8 ft. caps spaced 16 ft. centers, supporting 3 in. by 6 in. by 16 ft. joists spaced 2 ft. centers and finishing with a 2 in. by 6 in. floor laid at right angles to the track. The cost in 1921, using a price of $36 per M. ft. b. m. for lumber and 24 cents per lin. ft. for pile butts, averaged about $2.04 per lin. ft. of platform 8 ft. in width.

D. L. McKee (P. & L. E.) :—We have no elevated platforms at passenger stations but our experience with platforms at freight stations with the joists and floor raised above the ground shows that the air spaces add materially to the life of the platform. Our experience also shows that sleepers or joists laid on close centers add to the life of such platforms. The maintenance expense is also lessened if good heart wood material with a minimum amount of sap wood is used.

Wood Block

G. W. Andrews :—We have not used treated wood blocks on platforms to any extent, but from our experience with them on freight house platforms and floors, I am inclined to think that they will, if properly laid (and that means the same in anything, whether wood, concrete or brick) on the proper concrete base, and on an asphalt or coal tar bed, with the joints pitched, make a platform that will last as long as any platform that we can possibly build. I base that statement on a long experience that we have had in our freight house floors and platforms and shop floors. Many of those present passed through our large system shops at Mount Clare, Baltimore, in 1912. We commenced about that time to replace the floors with creosoted blocks until today nearly all of those shop floors are of treated wood blocks and the results have been most excellent.

Filled Platforms

Like most of the railroads in the country we have used almost every kind of platform. I think a cinder platform is the most abominable platform that can be put in. It is never cleanly; it is impossible for the station agent to keep the floors clean and it is impossible to keep the passenger cars clean. If I had my choice in the matter I never would build a cinder platform. When we have plenty of money we use brick but we are now replacing some of the platforms with wood.

D. L. McKee :—At points on the Pittsburgh and Lake Erie where

business is light or moderate, or at points where future improvements or changes are contemplated, our present method is to place a concrete precast curb in lengths of 5 ft. or to build a curb of second hand timber and fill in with a top coating of small limestone screenings or granulated slag. A wooden platform is built at one end of sufficient length to accommodate the handling of baggage trucks, this platform being laid with second hand material embedded in the earth and covered with 2-in. plank laid either at right angles or parallel with the track. At smaller points that might be termed " flag " or " no agent " stops, limestone screenings or granuated slag are used without a curb. These materials pack hard, give good service and are easily maintained.

J. J. Wishart:—On the New York, New Haven and Hartford we have some platforms built with a wood curbing, a crushed stone fill, with screenings on top and rolled down to a smooth hard surface. We also have common gravel platforms. On some divisions we are building platforms with concrete curbing, cinder fill and what is known as " Headley's Good Road " top, which is claimed to make a very good platform. I think the most economical plan for any railroad to adopt at outlying points at the present time is to replace the old wooden platform when it requires renewal with cinders to the top of the rail and then rolled hard. At places where there is considerable express traffic I would recommend a crushed stone top and a covering of screenings, well rolled.

E. K. Barrett:—On the Florida East Coast we have put in some filled platforms with concrete curb, using rock topped out with fine screenings and sometimes oiled. If this style of platform is used at a busy point the repairs to the top finish are found to be very heavy.

Wm. Sweeney:—At the smaller stations on the Chicago and Northwestern Ry., where we have combination freight and passenger depots we have built platforms with a timber curb anchored back with a piece of wood and an 8 in. by 8 in. tie. The platforms are then filled with cinders and a 3 in. stone screening top added except for a space about 6 ft. wide along the front which is covered with plank. From this runway next to the track we build runways to the freight house and waiting room doors. These platforms seem to give good satisfaction and are maintained at a very light cost.

C. S. Heritage:—On the Kansas City Southern we have platforms of shell, cinders and Joplin chats. Following are the specifi-

cations for a shell platform recently built in connection with one of our new depots:

"Platforms to be constructed of oyster shell after the curbing has thoroughly set. The contractor will fill the space with earth well settled, wet down and tamped to within 10 in. of the finished top of the curb, upon which he will fill with oyster shell, well settled, wet down and tamped to the level of the top of the curb. After the shell has been placed and the necessary crown or slope completed, the whole surface is to be thoroughly rolled so as to give a smooth, even surface. The shell will be furnished in cars by the railway company at the site which the contractor will be required to unload. Concrete curbing will be of the depth and sizes shown on drawings and to be of concrete as specified. Curb to have expansion joints 15 ft. apart."

Concrete

F. E. Weise:—The committee found in its investigation that there was much variation in experience with the concrete platform. There are some strong advocates of concrete who say that their experience is very satisfactory; there are others who say it does not make a satisfactory platform and they do not advise building it. This difference of opinion may be due to many things, as expressed in the committee's report.

D. L. McKee:—We have had very good success with our concrete platforms. They have stood up well. The main thing is to have a good foundation. Someone has mentioned the unloading of heavy freight on concrete platforms. Very fortunately for us, the most of our principal stations have four tracks and they cannot do that; they will if they have the opportunity, but on account of the four tracks they don't. We use considerable granulated slag.

We are compelled to maintain a safety line a short distance from the curb. If any of the members know what will maintain a good white line as a safety line, I would like to hear from them.

T. B. Turnbull (Ann Arbor):—We have been building concrete platforms for about 15 years. We thought that our ills were all over when we got them, but we found, especially at stations where trains are passing without stopping that in a great many places the concrete platform separates at the joints and spreads apart, due, no doubt, to vibration, letting water in at the joints. In a number of places we have also found surface flaking. Our first method was to put down a 5-in. concrete base and then a 5-in. top coat, but we have stopped doing this and now float it altogether in one mass. We

have not had so much trouble since we adopted this plan. We find breaks around the corners in a great many instances all along our railroad and we have trouble in keeping them in repair. Last year we had to break up and rebuild two platforms entirely, but we hope the homogeneous mass will overcome this.

E. Cahill (D. L. & W.) :—Practically all of our platforms are of concrete. They are in good shape and we do not have any trouble with them. Once in a while one will go bad, but as a rule they give good satisfaction. We also have brick platforms but they are not so satisfactory. They become so slippery in the winter time as to be dangerous.

C. U. Smith (C. M. & St. P.) :—I would like to ask Mr. McKee and Mr. Cahill what sort of curb construction they use adjacent to the track.

D. L. McKee :—We form the curb as we build the platform. In temporary work, we have a pre-cast curb, 5-ft. long and 8-in. wide at the bottom, provided with reinforcing rods. We do not use the pre-cast curb in permanent work.

C. U. Smith :—Is the curb which is used on permanent work a part of the top or separate from it?

D. L. McKee :—It is a part of it.

F. E. Weise :—How wide is it at the bottom when you build it in place?

D. L. McKee :—I am unable to tell you. It will vary from 12 in. to 16 in., depending on the location. We put in a good substantial curb. The success of a platform of concrete depends upon local conditions.

E. L. Sinclair (C. M. & St. P.) :—The specification quoted indicates that the C. M. & St. P. platforms are to be divided off into squares. I want to state that we build a great many platforms the full width and in sections about 30 ft. in length, which I think are more serviceable. There are fewer joints and there is less chance for them to wear. They give better satisfaction than when marked off into squares.

Secretary Lichty :—I was speaking to one of our Chicago and Northwestern men a short time ago who has had a great deal of experience with platforms. He said that it is poor practice to place longitudinal joints in concrete platforms. The joints should be at right angles with the track.

E. L. Sinclair :—Of course, the sections I speak of are the full

width of the platform. They are divided so as to give equal length of sections according to the length of the platform.

J. J. Wishart:—We built a number of concrete platforms between Back Bay (Boston) and Forest Hills about 1909 to 1911. The first ones built were cut into 3-ft. squares and the later ones into squares of 2½ ft., and those platforms are in as good condition today as when they were built.

Secretary Lichty:—I believe that where a good deal of trucking is done a large number of joints would prove detrimental. The only benefit I can imagine from having so many small squares would be that where a bad spot occurs, or one or more blocks become damaged, repairs can be made by replacing only such blocks as may be damaged without interfering with the rest of the platform.

G. W. Andrews:—We have had excellent results from the use of concrete platforms at some of our terminal stations but we have not had good results from their use at roadway stations, primarily due to the reason that freight trains want to unload their freight at the station as quickly as possible and they drop it on the platform. If they drop a heavy casting or crate on a concrete platform it may leave a mark that soon becomes a hole, and the hole soon becomes a subject for repair. When you have a repair you have an unsightly spot, and a spot that is either softer or harder than the original concrete. For that reason we have always opposed the building of concrete platforms at roadway stations, but in passenger stations where the wear is only from passenger traffic, we have had most excellent results and are still using it.

Wm. Sweeney:—The Chicago and Northwestern has had good service from concrete platforms. About five years ago one was built at Ripon, Wis., with the platform and the curb in one piece. We used second hand bridge bolts about two feet apart extending from the curb into the body of the platform. No joints were put in parallel to the track. This platform has been subjected to very heavy trucking and is in as good condition as the day it was built. We have a concrete platform at Manitowoc, Wis., that has been in use for 18 years and is in fairly good condition yet, with the exception of the wearing off at the joints parallel to the track. This platform has a stone curb 4 in. wide, 28 in. deep and in approximately 5-ft. sections, which is held in place by anchors made of ½-in. iron 3 in. wide split 4 in. at the end and bent over and set between each stone, and then anchored back under the concrete to a piece of concrete. This curb

maintains as good line and surface as the day it was placed.

A. B. McVay:—About 25 years ago the Louisville and Nashville tore out all wood passenger platforms at way stations where the platforms were maintained at a height of 6 in. above the top of rails and filled in with cinders or earth, giving a top coating of limestone screenings, without curbs. The surface was more or less bad and became muddy in wet weather. In recent years these have practically all been replaced with concrete, with a concrete curb on all sides, extending into the ground below reasonable frost line. The curb is first built in place with expansion joints at frequent intervals after which the joints are filled with melted asphalt. Then the surface between the curbs is leveled up and carefully packed after which a 6-in. top coating of cinders is added and on this is placed 4½ in. of concrete with a ½-in. trowel coat. Such platforms put down with proper mixtures and laid with expansion joints at proper intervals will last under heavy traffic for a long time. Holes that are worn by the action of truck wheels are difficult and expensive to repair. We have also had some breaks due to expansion. Tar and asphalt materials have been used for patching quite satisfactorily.

D6

A. O. Cunningham:—The standard platform of the Wabash is of concrete. It differs from that of other roads in that the floor slab, which is 6 in. thick extends to the outer face of and rests upon the curb. The curb is of concrete 6 in. thick and 24 in. high. All concrete floors are made in sections not exceeding 3 ft. square. The joints are ½-in. filled with bitumen.

C. S. Heritage:—Concrete platforms on the Kansas City Southern are built as follows: The passenger platform and that portion under the loggia is to be paved with a concrete base 4 in. thick, the same as specified for concrete floors, and to be finished with a top dressing ¾ in. thick as follows: Top dressing is to be made of one part Portland cement to one and one-half parts of clean, coarse sand thoroughly mixed dry and then troweled to a smooth even surface and blocked off into sections. Expansion joints are to be provided. There is to be no hardener in the platform finish. Concrete curbing is to be built in place of the same kind of concrete as is used for the building work and to extend around the entire outside of the platform, protected with a steel curb on the outside edges at the points shown on plans. All curbing that is exposed to view after paving and grading has been done will be finished with two good coats of cement wash.

Brick

F. E. Weise:—The brick platform seems to have many advocates. Mr. Cahill told us that his experience with the brick platform was not as satisfactory as with the concrete platform. He said they are likely to become quite slippery in the winter time.

E. M. McCabe (B. & A.):—We have a brick platform that is settling a great deal in places. I would like to ask the members of the committee if they have had any experience with brick platforms settling.

F. E. Weise:—Our investigation does not bring that out. Do you mean a brick platform with a concrete base?

E. M. McCabe:—Some of it had a hard base.

D7 F. E. Weise:—Some have said that they had this trouble with brick platforms on a sand cushion, but always followed with the statement that they were easily repaired because a portion of the platform could be taken up, the fault remedied and the brick replaced. Usually in the replacement the brick is laid a little higher than the old surface to allow it to settle back to a level with the platform.

J. P. Wood:—I believe that a great deal of the settlement is caused from the base not being properly prepared or given ample time for settlement to take place. We have had some experience along those lines, and we have found that where we had an opportunity to make the fill, we allowed it to be used until proper settlement took place, then put on the sand cushion, well tamped before placing the brick. In such cases we had very little trouble with settlement; in fact, I know of only one case where we made the proper preparation where we had any settlement to speak of, and that was over a sewer. We had another case where trouble resulted, owing to the fact that the fill was made in the winter time. We were rushed and did not allow ample time for proper settlement. The settlement, however, was not bad in any point. We had to take up the brick at three different places and put in more cushion sand to bring it up to surface.

Just another word as to brick platform becoming slippery in the winter time. That occurs in our northern climate, and from my observation and experience I am inclined to believe that a properly constructed concrete platform is preferable. The brick is rough and it does not give the station force an opportunity to clean the

snow and get it all removed, as on a concrete platform, leaving more or less snow which forms into ice at the joints.

G. W. Andrews:—Whenever we build a new station we put in a brick platform, and whenever we can get the money we replace our wooden platforms on the main line with the vitrified shale brick and concrete curbs. We have built some curbs in place, but most of them are cast in sections 5 ft. long at plants we have in Baltimore, and ship them to the site and set them up. It does not make any difference how much you raise the track and platform, you can always raise the sectional curb without destroying it whereas if the curb is built in place along the tracks, it is almost impossible to raise it.

Platforms built with vitrified shale brick will stand heavy and rough wear, and if properly laid will last many years. Most of ours have been laid on a sand base but in many cases we have put in the curb and filled with cinders, with a top dressing of stone screenings from our quarries, allowing that to remain until it becomes thoroughly settled. We then remove sufficient of the top dressing to receive the brick, and the results have been most excellent. The service has been of such a character that it has caused most of the B. & O. men to be willing to come to the use of the brick platform. When I say brick, I mean the vitrified shale brick of the same type and character as is used for street pavements and not the ordinary red building brick.

E. K. Barrett:—On the Florida East Coast our experience with brick top, concrete curb platforms has been very satisfactory. We have no frost to contend with. The curb is 4 in. thick and from 12 in. to 18 in. deep. The brick are laid on a good filling material 6 in. or more in depth with a 3-in. crown. Sometimes when thought necessary the brick is grouted. The costs in 1921 have been 48 cents per lin. ft. of curb and the average cost of the completed platform, including the curb has been $2.75 per sq. yd. This makes a very fine platform requiring practically no repairs. We have one which has been in use for 10 years on which no repairs have been required.

Wm. Sweeney:—The experience of the Chicago and Northwestern with brick platforms has been very satisfactory. The platform at Green Bay, Wis., has been in service some 22 years. The brick are laid on edge and are in fairly good condition yet. This platform has a stone curb of 6 in. by 30 in. by 5 ft. sections. The curb extends 16 in. above the surface and is in perfect line without anchors. The brick platform at Oshkosh, Wis., has been in use about

D9 25 years. This platform at first had a light stone curb, which gave way at various times because it had no anchors. It was later replaced by a concrete curb 9 in. thick at the base and tapered to 5 in. at the top, built in place. This curb was put in without anchors and is holding in line in first-class shape after many years of service.

D10 T. B. Turnbull:—We have a platform at our main passenger station, at Ann Arbor, built of 2-in. vitrified brick, which has been in use about 28 years. Except for some settlement which we have taken care of from time to time that platform is as good as it was when built. Therefore, I believe that the Ann Arbor will eventually adopt the brick platform with concrete curb as standard.

Sheet Asphalt or Mastic

F. E. Weise:—Has any one had any experience with sheet asphalt or mastic platforms? As stated in the report, we found that this type was used mainly in large terminals under cover.

D11 J. J. Wishart:—The Boston terminal has mastic platforms which were in service 24 years before being repaired. Recently some repairs were made by a mason crew and when their work was completed one would not know that the platforms had been patched. They appear to be in as good condition as when new.

J. S. Robinson:—The platforms of the Chicago and Northwestern terminal at Chicago are constructed of asphalt mastic. They have been in use since 1910 without any repairs whatsoever and are apparently in as good condition as when built. All of the baggage and express trucking is done on these platforms, besides their being used by 75,000 to 85,000 passengers per day.

These platforms are elevated, being on the second floor, and are sheltered by Bush type train sheds.

LINING TUNNELS UNDER TRAFFIC

REPORT OF COMMITTEE

The lining of tunnels under traffic presents difficulties and problems different from other projects encountered in railroad maintenance, in that one must not only care for the traffic, but must also arrange so that the traffic creates the minimum interference with the work. Otherwise the cost problem at once presents itself as an obstacle in the path of plans which may lead to future economy in maintenance work.

The reasons for lining a tunnel depend largely on the conditions surrounding it. A timber-lined tunnel no matter how short located on a busy trunk line at a point where detouring is prohibitive, or badly restricted, presents a hazard which may result in enormous cost, for while the earth formation may be such as to give no trouble from compressed sides or upheavals, there is the ever-present danger from fires, derailments and loads fouling the timbers, any one of which might delay traffic enough to cut into the revenue of the road seriously. A great many of the tunnels on the Southern Pacific Lines are bored through hills of loose formation, which when released, runs freely and in cases where the timbers have been torn or burned out, this loose rock and sand at once fill the tunnel carrying other adjacent arches and posts along with it.

Wet tunnels have been another source of annoyance on many lines. This excessive moisture not only causes track trouble but oftentimes creates side pressure and upheavals which endanger the stability of the tunnel and interfere with traffic. In some instances where tunnels have been bored with the intention of leaving them unlined, depending upon the stability of the rock, it has been found necessary to timber them finally and line them with concrete, due to the slacking of the rock face or to the slipping of the inclined strata.

The kind of lining selected upon differs somewhat on the various roads. Some roads deem it advisable to line with concrete only, others use concrete back walls and brick facing such as are found in many tunnels on the Baltimore & Ohio, where in single track tunnels the concrete is poured first and four rings

of brick put in as a final lining, while in double track tunnels five rings of brick constitutes the facing. It would be interesting to know why this extra brick lining is placed. It may be that it withstands the attack of the gas and acid from the locomotive exhaust better than the concrete, but the experience on the Southern Pacific Lines has been that there has been no decided disintegration of the concrete due to these causes.

The concrete lining has proven the most economical to install, especially with the present day methods—the pneumatic process being the latest development in this line. By this process the work may be carried on successfully with little interruption to traffic and to the work. There are various designs of machines for this work and the methods are divided as to the application of the lining. There is now a machine by which a grout of sand and cement is applied to the rock walls of the tunnel, either with or without reinforcement as the conditions warrant. Thus the grout is sprayed on the walls in successive layers until the desired thickness is attained. The aggregate is placed in a conical shaped hopper where it is mixed and thinned to the proper degree by the injection of water into the discharge pipe after the dry aggregate has left the machine. This has proved to be a satisfactory method of lining rock-faced tunnels where there is considerable seepage or where decomposition is setting in, but has not been used to any great extent in railroad tunnels otherwise. Cost data on this class of work were not obtainable and no effort was made to go into this subject on account of this method being used so little in lining railroad tunnels.

Lining Tunnels by Hand

Lining tunnels by the so-called hand method has been accomplished under traffic very economically under favorable circumstances. This is done in long tunnels by the use of the jumbo car with the staging high enough to permit of the concrete being shoveled into the form from this elevated platform. In some cases the side walls are poured ahead a considerable distance and the arch brought up later; in other cases the entire form is filled at one pouring, making a complete monolithic section. The difficulties encountered in this method are generally caused by the interference with the work by traffic, making the work spasmodic and creating an economical loss, which can

be overcome only by the strictest supervision and the employment of a small crew of men.

Where short tunnels are to be lined the hand method is probably the most practical. The staging can be erected high enough to give safe clearance for trains and also to give room enough to work. A continuous staging is thus carried along from the mouth of the tunnel and the concrete is conveyed from the outside of the tunnel to the form in one-yard mining cars on a track laid in the center of the staging.

On the Southern Pacific in some instances a 4 ft. by 5 ft. drift has been opened up over the top of the tunnel timbers, where the earth formation was favorable, a track laid on the tunnel timbers and the concrete carried into the form in dump cars. In this case the form can be poured to the top with little shoveling.

Wooden forms constructed of 3 in. by 8 in. studs, spaced 2 ft. on centers with 1 in. by 6 in. sheathing, and in 12 ft. sections are used. The form arch is hinged to the wall of the form with plates and bolts so that to move the form ahead it is only necessary to draw the side walls in and lower the arch enough to clear. Then the entire form is pulled ahead as far as necessary on pipe rollers and reset for filling. Waling pieces of 4 in. by 6 in. pine at the middle and top of the side walls are tied back by wire or bolts to the tunnel timbers, and the foot of the form is braced to the track ties. The open end of the form is closed up with 1 in. material and braced.

A spur track of four or five cars capacity is put in as near the tunnel as possible and sand and gravel unloaded on a plank floor. The cement house of two cars capacity is located as conveniently as possible to the mixer and also on the spur track so that the cement is handled as little as possible. The aggregate is hauled in wheelbarrows to the ½-yd. mixer, and after being mixed is elevated by a tower to the dump cars which are at the elevation of the tunnel staging or to the drift over the tunnel as the case may be. The cars are then run into the tunnel by gravity and are pulled back by a light cable from a donkey engine, which also does the hoisting.

This work is carried on with 20 men and averages about 36 ft. of tunnel lined per week with a single shift. Although the pneumatic machine was working on other tunnels in the vicinity.

it was not considered practical to use it on these short tunnels 200 ft. in length, as they were somewhat isolated and water service was poor at these points.

Several short pieces of lining were done by this method, the drift over the top being used only where it could be easily opened, but the work was found to cost more than with the pneumatic method.

Lining Tunnels by the Pneumatic Method

The Southern Pacific has now practically adopted the pneumatic method for the lining of its tunnels under traffic. The first piece of work of this nature consisted of enlarging to standard size and lining with concrete the tunnels on the Tehachapi Pass and the San Fernando tunnel, all of which are located on the single track main line, between San Francisco and Los Angeles. Of the 18 tunnels on the Tehachapi section, 11 were lined throughout by the pneumatic process, 2 were eliminated by a line change, 4 were lined by the hand method, being short jobs, and 1 was simply enlarged and not lined for the reason that it was of solid rock section throughout.

The line through the Tehachapi Pass follows the Tehachapi creek at various elevations along the steep slope to the creek, and all the tunnels are on 8 to 10 deg. curves. The formation of the earth consists of broken rock, loose sand and decomposed granite, so that in all cases the timbering was close.

The direct reasons for lining these tunnels were the constant danger from fires and cave-ins. In three instances derailments broke down several sets of timbers and delayed traffic of from one day to a week and in two other instances fires caused delays of from 9 days to 21 days. Swelling ground, falling rocks and sand drift caused minor delays at various times and with the traffic of two of the largest trunk lines going over this road, these delays caused losses amounting to enormous sums.

From one to five tunnel gangs were kept constantly at work repairing and retimbering these tunnels and the maintenance expense mounted to from $2,000 to $5,000 per month. It was therefore finally decided to enlarge and line the tunnels to a standard size with a minimum overhead clearance of 22 ft. and a minimum width of 16 ft. on tangent track and 17 ft. on curves of over 2 deg. The cross-section of the bore consists of vertical walls 14 ft. 6

in. to the spring line, and an arch of 8 ft. radius and 8 ft. 6 in. radius respectively for the 16 ft. and 17 ft. horizontal widths.

The difficulties encountered were numerous. The immense business carried by the Southern Pacific and the Santa Fe, which run jointly over this track, was the greatest problem to cope with, for not only were there 14 passenger trains and 8 scheduled freight trains daily, but in the busiest seasons as many as 67 trains were passed over this line in 24 hours. All ascending trains of course leave their trail of smoke and gas, which on calm days lies in the tunnels for long periods. On account of the heavy grades great care had to be exercised in flagging trains to protect the workmen, and a watchman was stationed near the tunnel to warn all men of the approach of trains. Because of these precautions the entire work was prosecuted with no injuries on this account.

Small electric units were installed to furnish light, which proved to be a great saving over the old torch method of lighting. In preparation of these tunnels for lining, the old timbering was removed and new 10 in. by 14 in. timbers installed on concrete footings, which furnished the basis for the future lining. The arches were of the three-segment octagon type, and gave a clearance of 23 ft. overhead and 19 ft. 6 in. horizontal for 17 ft. tunnels. All of the concrete lined tunnels were timbered throughout and the timbers left in place with the exception of spreaders or girts and all unnecessary woodwork, which were removed from between the timbers. Where it was necessary to install inverts on account of swelling ground, this was done after the lining was finished. Most of the tunnels were solidly lagged behind the posts and all cracks and holes were battened and plugged prior to setting the forms for concrete.

In laying out the plant on the outside it was found that a five-car spur was the greatest length that could be secured and in some instances only a two-car spur was possible. The spur was placed as near the tunnel as possible. Where a drag line was used to deliver the gravel to the mixer the spur was elevated four feet to give room to handle bottom dump cars, but where a clam shell was used it was not necessary to elevate the track as the cars could be unloaded by the clam shell.

Three different methods were employed to convey the gravel to the mixer. Wheelbarrows were first used, wheeling the rock and sand separately to a dipper, which was hoisted by a small

air motor. This required a fleet of eight wheelbarrows and six shovelers to keep gravel at the mixer and considerable lost time was experienced by this method. Besides these men it required eight more men to unload gravel from the cars.

To overcome this expensive feature a 25-yd. hopper was built over the mixer and a bucket elevator was installed at an expense of $700. The elevator was operated by air; it required only seven men to keep the hopper full, and there was no delay in getting gravel to the mixer. The spur track was also elevated and five men kept the cars empty. The gravel and sand were now delivered ready mixed in proper proportions. This elevator paid for itself quickly and this method was later improved upon by pulling the gravel up to the elevator with a drag line from a donkey engine. Three men now furnished gravel to the mixer and five men from the bull gang kept the cars empty.

Later on when a locomotive crane was available it was used to handle the gravel and proved to be the most economical of all, as with this crane the cars could be emptied and gravel supplied to the mixer with the use of only three men. Besides this the crane was a great labor saver in setting up the plant, loading and unloading material and made itself useful and economical in many ways about the work.

The cement house was placed adjacent to the mixer and also close to the spur track so that cement could be handled easily, both from the car and to the mixer. A three-car capacity cement house proved ample for the work.

The machine used for placing the concrete lining is simple and long-lived. It consists of a cone-shaped hopper with a trap door at the top and a cast iron elbow at the bottom or apex of the cone. The hopper is built of ¾-in. steel plates and is made in ¼-yd. and ½-yd. sizes. A 6 in. discharge pipe is used for the ¼-yd. batch.

These machines have come into general use on many roads for lining tunnels under traffic and have proved to be very satisfactory, both as regards the quality of concrete produced and the economy of applying the lining, although the economy in this process is governed largely by the extent of the work to be done, for the reason that the initial cost of the plant would be prohibitive if only a small number of short tunnels were to be lined.

In the Southern Pacific work the ¼-yd. type was used and was located as near the gravel storage as possible to facilitate

the handling of the gravel. Over the mixer a 25-yd. hopper 10 ft. square was built in sections so that it could be taken down and moved easily. The gravel is drawn from this hopper through an air-operated gate at its lower point into a ¼-yd. measuring hopper and thence into the mixer. This is done quickly and it requires but a few seconds to load the mixer with the charge.

The compressor was of the Ingersoll-Rand Imperial Type 10, having a capacity of 925 cu. ft. per minute. It was belt driven by a 160 h. p. gas engine. Both engine and compressor were installed in a steel frame box car in order to make them portable as the conditions demanded. The car, when located in a suitable place, was lifted from its trucks and rested on wooden frame bents on concrete. The car was braced at each end with I-beams to the rails, which, with 18-in. screw jacks, took up the thrust of the car when the engine was working.

Two 3 in. pipe lines carried the air from the compressor to the mixer, and the air storage consisted of small tanks with a total of 400 cu. ft. capacity. This capacity was ample for a shot of 1200 ft. and was reduced to 140 cu. ft. for the shortest shot of 250 ft.

As this entire plant was to be used at all tunnels over 200 ft. in length it had to be made portable, and it generally required seven 8-hr. days to set it up, and the same length of time to prepare 100 ft. of tunnel and set up the steel forms ready to fill, with a force of 40 men.

Five steel ribbed forms of the Blaw collapsible type were used, each form being 20 ft. long, and covered with 3 in. pine lagging. All forms were set up outside the tunnel and rolled in on their own wheels, on a light rail spaced 25 in. from the face of the concrete on either side, and 3 in. below the top of the main line rail. The forms were spaced in the tunnel so that they would operate toward each other, the intention being that all forms should cover the discharge pipe.

From the mixer a 6 in. standard steel pipe was laid into the tunnel. The pipe was connected with 6-hole cast iron flanges, and extra heavy pipe was used for bends. The pipe was laid on the ground to a point midway between two forms where it arose to the top center of the tunnel through the extra heavy bends. It was then carried on hangers in the top of the tunnel. By reversing one elbow two forms could be shot with one set-up of the pipe. The same procedure was followed with the other two

forms, but the fifth form required a separate set-up of pipe. As two forms were filled the ground connections of the pipe were changed and the next two filled. This could be done in 30 minutes at least and when no delays occurred shooting could be resumed in the next form in that length of time. The pipe was anchored to the timbers with chains and turnbuckles as the thrust was very severe at times, and it would break at the flanges quickly unless so anchored.

On the end of the pipe at the form a 6 ft. nozzle, consisting of extra heavy 6 in. pipe, with a slight curve in it, was flanged on. This deflected the concrete to the side walls until the concrete arose to the crown of the arch on each side. It was then removed and a straight pipe put on to finish the key of the arch.

One-half inch steel plates were used as baffle plates on the timbers to keep them from being cut through by the concrete, and were removed when the concrete reached that height. It was also necessary to put steel sheets 4 ft. by 10 ft. by 1-16 in. thick on the forms where the concrete struck, otherwise the lagging soon became rough and caused trouble. Care was taken to keep the forms well cleaned and oiled to prevent sticking. The forms were cleaned by air. A 1-in. line laid through the tunnel from the air reservoir furnished air for this purpose, and, with a hose and short pipe nozzle, the loft man could keep the form clean by blowing all loose rock and concrete off when necessary.

The discharge pipe gave considerable trouble in the early stages of the game through wearing out at the bends, but this was overcome by case-hardening and putting on heavy patches with clamps. In this manner 1,000 to 1,500 yds. could be shot through a bend before it became useless.

The forms when placed were raised and spread by screws attached to them, but it was necessary to block the form ribs up well and tie the forms back to the tunnel timbers with ¾-in. bolts at the center and at the spring line. The foot of the form was braced to the track ties and it was found that considerable bracing and tying was necessary to hold the form in place successfully on account of the rapidly increasing weight as the form was filled, for the concrete was practically alive until the entire side was filled. Many times it was found necessary to allow some time for setting by changing the pipe from one side of the form to the other side, where the tunnel was only partially lagged up back of the timbers or where large cavities occurred. An

electric bell with a code of signals was used to advise the mixer operator when to start shooting and when to stop, and to give him other necessary information as to the progress of filling the form. The concrete placed by this method was found to be well mixed and of a good quality when crushed rock of 1 in. to 1½ in. size was used with good, clean sand, but round rock and pebbles did not do as well as they had a tendency to roll into pockets, which sometimes caused considerable trouble.

It was found necessary to have a man patrol the line with a hammer as the concrete frequently stuck in the pipe and had to be hammered loose. In the long tunnels two or more men were necessary in order to prevent delays on this account. In an effort to overcome this sticking or plugging and to give more plasticity to the concrete, hydrated lime was added to the batch. One-quarter of a cubic foot was added to each ¼-yd. batch, but no improvement was noted, and the only remedy seemed to be to add more water. Under these conditions the sticking was very much minimized but it became much harder to hold this excess fluid in the form, although the quality of the concrete appeared to be as good or better than with the dryer mix.

The concrete was reinforced with ¾-in. twisted or deformed steel bars spaced 12 in. on centers for the vertical steel and the arch, and 24 in. on centers for the horizontal steel. Twisted steel plugs were left protruding 9 in. out of the concrete footings, when built, to tie to, and all the steel was securely tied with No. 14 annealed wire.

The aggregate was furnished in 1:2:4: proportions and was put into the mixer dry, and 10 to 12 gal. of water added. Everything was arranged so that rock, sand, cement and water could all go into the mixer at once. When shooting from 150 ft. to 200 ft. we could shoot as high as 96 batches per hour, for distances of 700 ft. to 800 ft., 60 batches per hour, and at 1,200 ft., 45 batches.

To operate the plant successfully sufficient water should be on hand. In these tunnels water was taken from a 6 in. gravity line by installing a valve. This, with the addition of a 2,000 gal. tank, elevated 60 ft. above the plant, gave sufficient pressure for the engine and mixer, as well as for camp and other purposes.

To shoot the concrete successfully it was found necessary to maintain an air pressure of from 75 lbs. to 90 lbs. in the receivers. When shooting at 80 lb. pressure a drop of 20 lb. oc-

. . . . which was entirely discharged. This varied . . . . from the mixer to the form, but the maximum . . . . 40 cu. ft. air receivers was 30 lb. when shoot- . . . . 1,200 ft.

. . . . . . progressed and the two forms approached each . . . . from 10 ft. to 14 ft. was allowed as a finish form. This . . . was finally filled through a 2 ft. by 4 ft. recess left in the top and end of the last section of concrete. Through this hole the pipe was inserted and the hole was big enough for the loft man to crawl through to clean the form. When the form was filled the pipe was pulled out and this recess reinforced and filled, completing the work.

The forms were then rolled out and in one case were hauled intact to another tunnel a mile distant by work train with no delays to trains and all in five hours. Otherwise the forms had to be dismantled and knocked down to move to the next job.

As in all concrete work, continuous pouring of a unit produces the best results, so in tunnel lining a section should be completed in the shortest time possible to avoid seams and offsets in the concrete. It was therefore found most practical to work two 8-hr. shifts, one shift starting at 6 a. m. and working until 3 p. m., and the other shift continuing on from 3 p. m. to 12 o'clock midnight, taking the usual hour for lunch. In this way a section of 20 ft. could be completed each day.

After completing the section and making another form ready the night shift changed the pipe and did what other work was necessary for the day shift to start promptly after 6 a. m. on the work of placing concrete.

Six 20-ft. sections were completed each week with the double shift and in some cases of short shooting seven could easily have been blown, but the lack of forms and the four days required for setting of the concrete, made it impossible to complete seven sections in six days.

The forms varied somewhat in the amount of concrete necessary to fill them. This variation was due to the nature of the lagging in the tunnel. Some portions of the tunnels had no lagging where good rock was encountered and in these instances the concrete filled all cavities and voids in the rocks and, of course, required more filling as it was not considered practical to fill these voids other than with the concrete. Some 20 ft. sec-

tions of this nature required from 90 yd. to 105 yd., but the ordinary section, where timbers were well lagged, required an average of 80 yd. or 3.5 yd. per tunnel foot.

A crew of 40 men was used on the day shift, consisting of a foreman and two assistants, 16 carpenters, an electrician, an engineer and helper, a pipe man and helper, a craneman, timekeeper, 3 flagmen and 12 laborers. The night shift was composed of 20 to 25 men, consisting of the foreman, an assistant, 8 carpenters, an electrician, an engineer and helper, a craneman and 6 or 8 laborers. As the day crew did the bulk of the work, the night crew was not necessarily as large, as it was considered practical to start blowing a new form and let it set unfinished for six hours.

The cost of these tunnels varied somewhat owing to conditions on the ground, the fluctuation in wages and the uncertainty of delivery of material, during the 57 months that the work was in progress. Costly delays were experienced through labor shortage and lack of material delivery. During the time that this work was in progress the weather conditions were favorable, there being little snow and frost to contend with as on other jobs in colder climates.

The cost data on a typical tunnel 684 ft. long lined by the pneumatic method is reflected by the following figures. This is Tunnel No. 3 of the series on the Tehachapi Pass. In this case we had a spur track of 4-car capacity. Material was supplied to the job by local train service and very irregular. Considerable delay was caused through lack of material delivery from a commercial plant located 200 miles from the tunnel. The work was done during a period of extremely high wages, carpenters and mechanics receiving as high as 83 cents and laborers 51 cents per hour. One shift of 8 hours only was used and the gang consisted of about 35 men. Gravel was delivered to the mixer by a drag line and elevator, which was somewhat costlier than handling by the crane as was done on later jobs. The entire cost of concreting this tunnel was $31 per lineal foot for labor and $33 per lineal foot for material.

Knowing little about the handling of the plant it took some time to perfect an organization whereby an economical showing could be made, but considering circumstances and the difficulties under which the work was done, it was considered that a very satisfactory showing was made.

The accompanying photograph shows No. 1, a steel form in the process of erection; No. 2, a steel form in place in the tunnel and ready to fill and one method of erecting the pipe line where one form only was served by the pipe. (See page 155).

The work was carried on by company forces. Geo. Rear, bridge engineer for the Southern Pacific Co., engineered the work of putting the machinery in motion and lining the tunnels. A. Fraser, supervisor of bridges and buildings at Bakersfield, supervised it, and the chairman executed the job of lining.

Lining the San Fernando Tunnel

The lining of the San Fernando tunnel is being prosecuted in a somewhat different manner with respect to the form work and the execution of the work in general. The lining is carried on in conjunction with the enlargement of the bore and as the traffic is approximately 50 per cent lighter at this point and other rail connections give an outlet for traffic in case of trouble, the work has not been followed so intensively as in the tunnels on the Tehachapi Pass. This tunnel is 6,696 ft. in length and is cut through a rugged range of hills composed of sandstone, conglomerate, shale and solidified ocean mud. It is located 25 mi. west of Los Angeles on the Southern Pacific main line. The work is being done by C. W. McCandless, under the direction of G. W. Corrigan, division engineer, and J. Gratto, supervisor of bridges and buildings. The lining was started in July, 1919, and to date some 2,300 ft. has been completed.

The cross-section of the bore is vertical walls with an arch of 8 ft. radius, the finished width being 16 ft. and the overhead clearance 22 ft.

The reason for the lining of this tunnel was to eliminate danger from cave-ins, fires and wrecks, as well as to reduce the maintenance cost and the interference with traffic. The outstanding danger in this tunnel is the swelling or upheaving ground, which at times has blocked the tunnel to such an extent that enormous expense has been incurred in the restoration of traffic. The reduction of this maintenance expense, which amounts to more than the annual interest on the cost of lining the tunnel, favored the lining as it was necessary to keep a gang of 15 to 30 men at work in the tunnel constantly.

The reinforcement of the concrete is the Southern Pacific standard, as in other tunnels, and the volume of concrete per tunnel foot the same. The pneumatic method is used here much

in the same manner as in the lining of the Tehachapi tunnels, with the exception that it is not necessary to have such large storage capacity for the aggregate and the rock and sand are handled by wheelbarrows.

Two compressors furnish air for the blowing at this tunnel and are electrically driven. As the power lines of the Southern California Edison Co. are in close proximity to the work it was deemed advisable to obtain this power. One Ingersoll-Rand compressor has a capacity of 1,150 cu. ft. per minute and the other, a Chicago Pneumatic compressor, has a similar capacity.

Two compressors are used here instead of one on account of the long shooting, the distance of the shortest shot being 2,300 ft. It is figured that as the air is exhausted from one compressor the volume of air in storage from the other compressor can be quickly turned into the line, following up the batch and driving it on to the form.

The mixer is a Pneumatic Concrete Placing Co.'s machine of ¼-yd. capacity and a 6-in. pipe line is used as a discharge pipe, flanged at the joints with standard cast iron 6-hole pipe flanges. Wooden forms are constructed of 2 in. by 6 in. pine doubled for studs and placed 2 ft. on centers with 1 in. by 6 in. S1S pine for horizontal sheathing. The side forms are held firmly in place by ⅝-in. bolts with heads spiked to the tunnel posts, one on each side of the post, the threaded ends projecting through the form and through waling strips of 2 in. by 6 in. pine doubled, 4 ft. on centers.

The arch ribs are made of six-segment two-ply 2 in. by 12 in. rough pine bolted together with 4 in. by 6 in. tie beams 18 ft. above the top of rail, as a spreader. This gives a stable arch and one which can be handled conveniently. The arch rib ends drop to a point about 12 in. above the spring line to a 2 in. by 6 in. plate. Between this plate and a similar plate on the top of the side walls, short 2 in. by 6 in. studs are inserted which are knocked down when the arch is ready to be dropped. This gives ample clearance for the arch in moving it ahead to the next section. The walls and arches are in 12-ft. sections and, in placing the concrete, the entire form is filled before moving ahead, making a completed section. The concrete footings were installed along with the retimbering and enlarging of the bore, this work being done by hand only.

The 6-in. discharge pipe from the mixer rises from the

ground when within 300 ft. of the form to be blown The only bends used consist of short 45 deg. cast iron elbows of approximately 3-ft. radius. By the use of these cast elbows the pipe is carried to the center of the top of the tunnel where it is supported by round iron hangers to the top segment of the tunnel arch. No special nozzle is used on this pipe, the concrete being discharged into the form directly from the straight pipe.

When it is necessary to pour a section between two sections previously completed the pipe is brought up to a height beneath the form that will clear trains and then turned vertically through the center of the form an equal distance from the ends of the form. A recess is excavated in the roof of the tunnel, planked up and baffle plates put in. This recess is large enough that the concrete, when striking the roof, will spread itself equally in all directions. The pipe is projected about five feet above the inside of the form so that the concrete cannot run back down and so that the form will be well filled. The pipe is then disconnected and plugged with sacks and pulled down out of the form. In this manner the lining progresses at the rate of from 12 ft. to 18 ft. per day of eight hours when shooting, but no attempt is being made to shoot every day. A section is placed three times a week, the other three days being used to erect reinforcing steel and the forms. The length of the form is regulated to suit the distance of shooting and the rapidity of discharge, which is governed by the distance from the mixer to the point of discharge, or the form, and varies from 12 ft. at a distance of 2,000 ft., to 18 ft. at a distance of 800 ft. to 1,000 ft. By so regulating the work it is possible to complete a section within the eight hours.

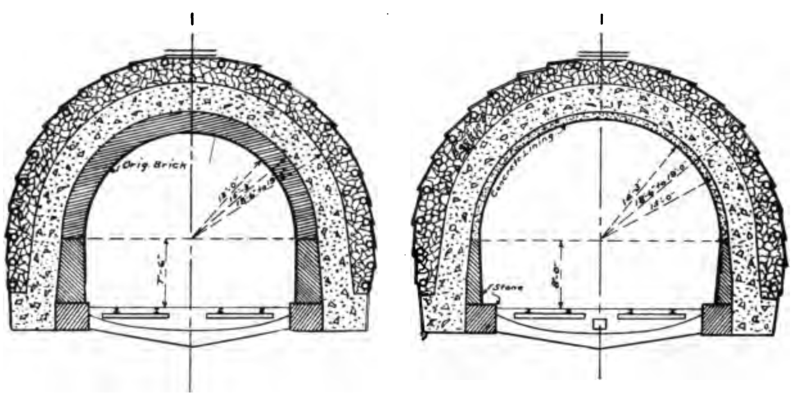
The personnel of the force engaged in enlarging and lining consists of a general foreman, two assistant foremen engaged in enlarging and retimbering ahead of the concreting, and 40 other miscellaneous men such as carpenters, laborers, flagmen and watchmen, there being a total of 45 men in all.

This work has thus been carried on very methodically and economically. The object in this tunnel is to carry on the lining in conjunction with the enlarging and retimbering of the section and by so doing a material saving is effected, in that it is possible to eliminate some of the otherwise necessarily heavy timbering. By prosecuting the work in this manner at this tunnel it has been possible to place 750 ft. of this concrete lining, together with the

footings, at a cost of $24 per lineal foot for labor, and a total of $53.06 per lineal foot for labor and material, exclusive of superintendence, tool rental, store expense and other incidentals.

Lining Two Tunnels on the Lehigh Valley

Two novel methods were used by the Lehigh Valley in relining short sections of two of their tunnels which are illustrated herein. One, a double track tunnel, was partly lined with brick when constructed, but as time went on the brick disintegrated and bulged to such an extent as to become dangerous and clearances were reduced. In 1890 a shaft was dug from the top of the ground above the tunnel down to the top of the brick arch and a second arch and side walls were built around the whole of the original tunnel, and then the brick arch was removed and



Relining Tunnels, Lehigh Valley R. R.

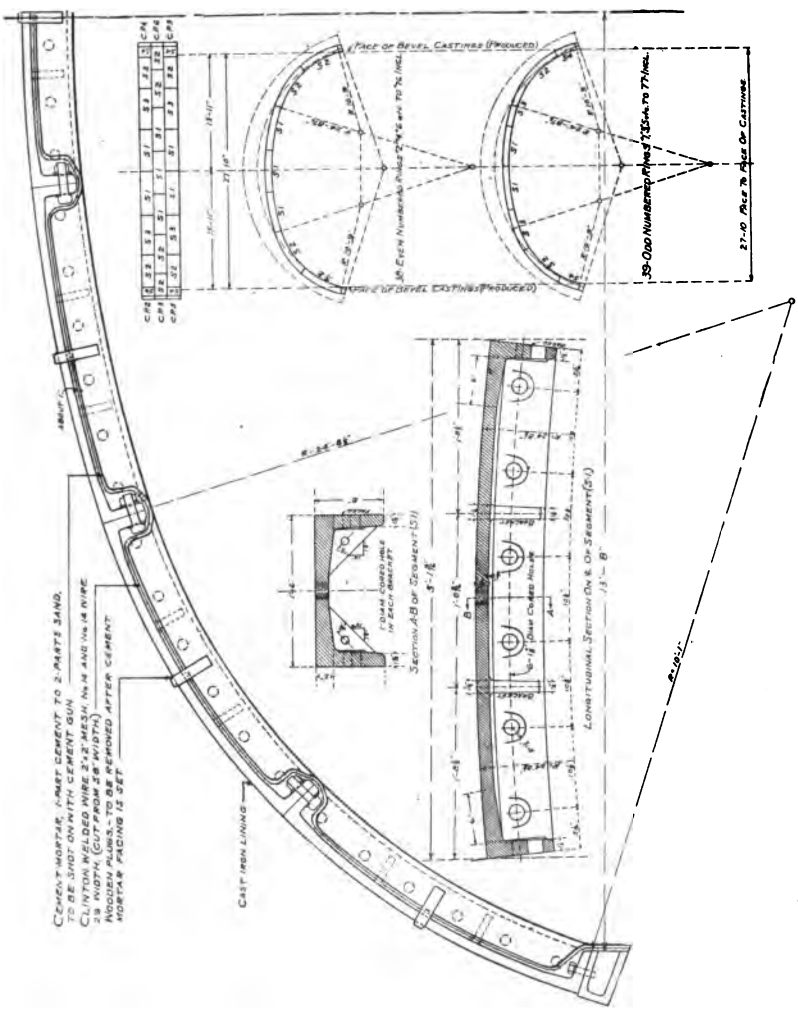
the inner surface of the new concrete arch faced to produce clear and neat surface lines. During the progress of the work, a single track was operated through the center and before the work of excavation for the inner arch was started the part of the tunnel under repairs was completely supported by temporary bents, the centering thoroughly wedged to the old arch for its support, and the pressure produced by the soil from the rear or top.

The other tunnel was completely arched with brick when constructed, about 1886. A few years ago about 115 lineal feet of the arch showed some signs of sagging and bulging. This tunnel is also double track, and all the clearances available were required for the traffic, especially near the eaves of the equipment. Directly above the centers of the tracks and between the

tracks, some space could be spared. At this tunnel the side walls are of stone to the springing line. This brick was built of separate arches, 21 in. thick.

The defective section of the tunnel was lined with cast iron segmental arch sections bolted together at the ends and along the sides through flanges. At the springing line, and for a short distance upward, part of the brick arch was cut away to make room for the cast iron lining.

This lining was shaped so as to form a complete but flatter



Segmental Cast Iron Tunnel Lining, Lehigh Valley R. R.

arch under the brick arch, and the space between the cast iron arch and the brick was grouted with a cement gun; this was done for each complete ring separately as it was completed. After all the cast iron lining was in position, steel-crete metal was wrapped about the flanges of the cast ribs and the whole inside surface, (including the bolts), covered with a thin layer of gunite, placed with a cement gun, to prevent destruction of the metal by the gases from passing locomotives.

To do this work, single track was operated through the tunnel and the defective section completely centered to support the brick arch; this centering was replaced as fast as the cast iron sections were placed. This was a very interesting piece of work and required a good deal of study, but was completed successfully.

Connaught Tunnel—Canadian Pacific Ry.

The five-mile double-track Connaught tunnel of the Canadian Pacific under the Selkirk mountains near Rogers Pass has just recently been lined with concrete. The construction plant and equipment presented some exceptional problems. To them may be added an altitude of 4,000 ft. above sea level, an average snowfall during the winter of 40 ft. and a distance of 220 and 420 miles to the nearest cities where materials, equipment, and labor could be obtained.

The principal requirements for the plant were the storage and handling of material outside the tunnel, the transportation of men and material into and out of the tunnel, lighting and the mixing and placing of the concrete.

The plant itself had to be laid out with special consideration to safety, non-interference with railway operation, non-interference with signal and other circuits, fire hazard, reasonable and economic speed in performance and special weather conditions in the mountains. Practically every variety of layout was considered to meet the above conditions.

It was decided to construct a central electric generating station which supplied power sufficient for brilliant lighting of the working zones within the tunnel and for the operation of a plant mounted on cars, consisting of air compressor with its operating motor and auxiliary apparatus, storage space for the materials for the aggregate, and motor operated mechanical premixing and air-placing concrete apparatus. A transmission line to the working zones, transformers, low tension lines to lights

and motors, and a gasoline locomotive for hauling this plant and the supply cars were the necessary adjuncts of the plan.

The heart of this scheme was the electric power plant which was located near the west portal of the tunnel at Glacier station. On account of the topography it was not feasible to place the power plant at the main line level, and it was therefore located on an embankment south of the railroad. Three old locomotive boilers were used for the power plant.

Immediately after the passage of trains, particularly when operating against the one per cent grade in the tunnel, smoke conditions made work extremely difficult. Most careful consideration was given to a variety of schemes for illuminating the working sections under smoke conditions and at the same time for not over-illuminating the work after the smoke had cleared. Numerous laboratory experiments were made. Flood lights of 500-watt capacity each were finally decided upon. These lights were portable and adjustable as to diffusion of beam, and worked out in practice exceedingly well, permitting illumination to be varied immediately to meet any particular set of conditions obtaining in the tunnel at any time. They also cut the time lost due to smoke and showed a large saving in labor costs.

Two 75-ton pit flat cars were coupled together to carry the concrete mixing and placing apparatus. On one car was located a 1,290-ft. motor-driven compressor, while on the other car was located a mechanical concrete mixer of 22 cu. yd. per hour capacity and a pneumatic placing apparatus of the same capacity. Storage bins for sand and gravel were provided on each car with a belt conveyor to carry material from one car to the other. Cement storage and water tanks were located convenient to the mixer. Storage was calculated on a basis of blowing a complete form without leaving the tunnel to recharge. Sand and gravel were delivered to the mixer skip by gravity and the mixed concrete dropped by gravity into the air placer. Necessary pipe and flexible hose connections to the forms were used.

In operation the cars were spotted near the forms to be blown and jacked up in order to take the weight off the springs. Electric power connection was made to the nearest outlet on the power distribution line. No difficulty was experienced from vibration or rocking, although the compressor motor had a capacity of 200-h. p. at 500 r. p. m.

A 27-ton gasoline locomotive was used for hauling the mixer

cars in and out of the tunnel, the handling of the rock scaling and derrick cars, material cars, switching of cars in the yard, etc. It was also used in running lunch cars into the tunnel in order to save working time otherwise consumed by the men going out for lunch, and in general the many miscellaneous switching uses continually arising on work of this kind. The engine was rated to handle 210 tons on a one per cent grade and was operated by one man. An electric locomotive would have imposed excessive costs and a steam locomotive would have aggravated smoke conditions. The effect of the exhaust gases from the gasoline locomotive was carefully considered but found to be negligible.

Six Blaw-Knox collapsible steel forms were used, each providing 20 ft. of finished tunnel lining at one placement. These were made to clear all traffic. Each form was on wheels and after the concrete was set the top plates were collapsed and the forms rolled forward to their new position.

The proper and comfortable accommodation for 200 men in the heart of the mountains was an important and difficult question. A complete camp complying with Government regulations was gradually built up, consisting of sleeping quarters, subdivided into units of four men each, bathhouse and laundry, separate small houses for married men, community dining room, kitchen, storehouse, roothouse, etc., comprising a total of about 60 buildings. All quarters were electric lighted and provided with water. Heat was furnished by stoves. A drainage system and septic tanks were installed.

SANDY RIDGE TUNNEL

(From Engineering News, November 16, 1916)

The Sandy Ridge Tunnel on the Elkhorn extension of the Carolina, Clinchfield & Ohio Ry. which was opened for traffic in 1915, is being lined with concrete under traffic, the pneumatic process of concrete being used, with the novel addition of a portable mixing and placing plant. The system comprises the following elements: a self-propelled mixer car, a loading and storage trestle, a compressed air plant outside the tunnel, an air pipe line through the tunnel, and forms that can be easily erected, moved and taken down. The tunnel is 7,804 ft. long by 19 ft. wide.

The central element of the method is the concreting car, which is a steel frame, gasoline motor-driven car, carrying a pneumatic

concrete mixer and space for aggregate, cement and water. It is run into the tunnel on the regular railway tracks and mixes and delivers the concrete through the medium of air compressed outside the tunnel and delivered through a pipe line with regular spaced taps, to which the mixer on the car is attached.

The dimensions of the car are 40 ft. long over end sills, 10 ft. 4½ in. wide over braces and 17 ft. 9 in. from top of rail to top of car. A central chamber open on the sides, 8½ ft. long, 9 ft. 8 in. wide, and 10 ft. 3 in. high contains on one side the pneumatic concrete mixer and on the other side the charging skip. Over this chamber is a water tank of 1,850 gal. capacity. This furnishes water for the concrete and is also connected with the cooling system for the gasoline engine.

Facing the central chamber is the stone bin (30 cu. yd. capacity) on one end and the sand bin (12 cu. yd. capacity) on the other. Each bin has a chute 20 in. wide leading to the charging skip, and each chute is controlled by an undercut gate. Under this stone bin is space occupied by a 96-cu. ft. air receiver standing vertically and also space for storage of bags of cement, which is protected from water by the bin overhead.

Under the sand bin, is the gasoline engine and its auxiliary equipment completely housed from water and dust. In its lower position the charging skip stands with its top rim about 1 ft. 3 in. above the floor, and it travels on inclined guide-rails (40-lb. T-rails) to its upper position over the mixer, being hoisted by a compressed-air cylinder 9¼ in. diam. The gate of the skip works automatically by means of a guide-rail. The mixer is for a two-bag batch (4/10 cu. yd.) and has its 8-in. outlet pipe at the bottom running horizontally and curving to the outside of the rear truck and thence vertically to near the top of the car, where it branches by means of a Y into two lines—one a 180 deg. bend to the rear for shooting in foundation and sidewall and the other going to the roof for shooting into the arch.

The entire arrangement is made compact with a view to saving manual labor. One man controls the hoisting of the skip, injection of water and mixing and discharge of the batch. One man is placed at each chute, and two men carry, open and empty, the cement bags. The car and gasoline engine were built by the McKeen Motor Car Co., of Omaha, Neb. The car was sent knocked down and was erected in the railway shops at Erwin, Tenn., and

moved to the work (105 mi.) under its own power, traveling at speeds of as high as 25 mi. per hour.

The mixer was installed and the piping done on the car by the Pneumatic Placing Company of New York City.

Loading and Storage Trestle

The service trestle is of special design and is so arranged that the concreting car goes under it and receives stone (crusher run), sand, cement (in bags) and water, all by gravity and frequently all at the same time. The sand and stone are drawn from overhead bins by means of undercut gates. Cement is conveyed into the car by a chute. The trestle has over its deck a track upon which stone and sand in hopper cars are stored or unloaded into the bins below. There is a continuous row of 27 bins with an aggregate capacity of 324 cu. yds. and a total length of 162 ft., and five loaded cars can be stored over these bins, giving additional storage of 200 cu. yd. The trestle is built of timber and has a somewhat unusual arrangement of posts and bracing.

The forms are of steel, except the arch ring, which is of 3-in. hard pine on steel ribs. They are of the Blaw collapsible type and are held to the rock wall by anchor bolts. First a hole is drilled in the rock, and a rod 18 to 20 in. long, split at one end and threaded at the other, is inserted, with the point of a wedge just entering the split. The rod is driven against the end of the hole, causing the wedge to spread the split end. A square cast coupling or nut is screwed on the tapped end of the rod, and a second rod is screwed into the outer end of the coupling. A similar coupling is placed on the free end of this second rod and the last section of the hanger is screwed into this coupling.

The most important feature of the hanger is the square couplings, whose shape prevents their turning in the concrete when the outer rod is unscrewed. Pipe couplings were tried at first, but being round, they turned with the rod and gave much trouble. Standard bolt thread is used as being more satisfactory than standard pipe thread. Five 30-ft. sections of forms are provided, and these are distributed through the tunnel as seems best. On account of pressure of the wet concrete an entire section is not concreted in one operation. After concreting the walls up to the spring-line the car moves to another section. Had it been possible to place concrete at full capacity, the five sections would probably have proved inadequate to keep the car busy. Difficulty in obtaining

sufficient cement—due to some local conditions—kept the rate of progress notably low.

Sand-Bag Bulkhead Retains Concrete

When a section is moved to a new position, one end is caused to overlap the concrete last placed. At the other end of the form a bulkhead of sand bags is constructed. Burlap bags are preferable, but cement bags also can be used. These are half filled with sand and are stacked a foot thick all around the opening, the bulkhead rising with the concreting.

The concreting car was put in service on July 9, 1915. The high record for concrete placed in one day was 230 cu. yd., on May 12, 1916. The daily records and monthly totals for the summer months just passed were respectively as follows: June, 214 yd., total of 4,098; July, 191, total of 1,570; August, 154, total of 508; to Sept. 20, 184, total of 1,347.

The maximum advance was made in May, 1916, the weekly totals being as follows: First week, 590 cu. yd.; second, 1020 cu. yd.; third, 1,098 cu. yd.; fourth, 990 cu. yd.; fifth, 564 cu. yd. The total concrete placed from July 1, 1915 to Oct. 31, 1915 was 10,438 cu. yd., while from the latter date to Apr. 30, 1916, the weekly totals averaged more than 600 cu. yd. It is expected that the tunnel lining will be finished next summer. The work is being done by the company forces under the general direction of O. K. Morgan, chief engineer in charge of the railway, who also designed the car.

Lining the St. Paul Pass Tunnel

By C. F. Urbutt and S. H. George

When the Chicago, Milwaukee and St. Paul built its Puget Sound extension from the Missouri River crossing at Mobridge, So. Dak., to Seattle and Tacoma, Wash., it was found necessary to tunnel the mountains many times. One of the most interesting of these is the St. Paul Pass tunnel at the summit of the Bitter Root mountains on the boundary line between Montana and Idaho, which is 8,771 ft. long and was driven and timber lined throughout, with the exception of 1,3C0 ft. of rock section. The construction started with the driving of the heading at the east portal on Jan. 8, 1907, and at the west portal on Aug. 12, 1907. The east bench was begun in September, 1907, and the west bench in January, 1908. The headings met on Feb. 9, 1909, at Station 45+31 and the benches on March 4, 1909, at Station 43+24.

Shortly after the completion of the tunnel the two portals and five short interior sections, amounting in all to 753 ft., were lined with concrete. This concreting was done between July, 1909, and October, 1910. It is with the lining of the remainder of the tunnel, amounting to 8,018 ft., that the following report deals.

The work was in charge of: C. F. Loweth, chief engineer; E. O. Reeder, assistant chief engineer; J. F. Pinson, assistant engineer from May 15, 1915, to June 20, 1916. C. F. Urbutt, assistant engineer from June 20, 1916, to completion on Feb. 1, 1917, and S. H. George, assistant engineer from May 15, 1915, to completion on Feb. 1, 1917.

The lining was started on June 20, 1915, and completed on December 8, 1916. Grouting was started with one car on Sept. 30, 1916, a second car started on Oct. 18, 1916, and a third car started on October 30, 1916. The work was completed on February 10, 1917.

The east portal was on a comparatively flat hillside and there was sufficient room for the erection of the plant and camp. The most serious obstacle was the handling of a snow water creek that discharged just above the portal and made necessary the construction of a flume to handle the water to permit the efficient handling of the equipment situated under the snow shed at the portal.

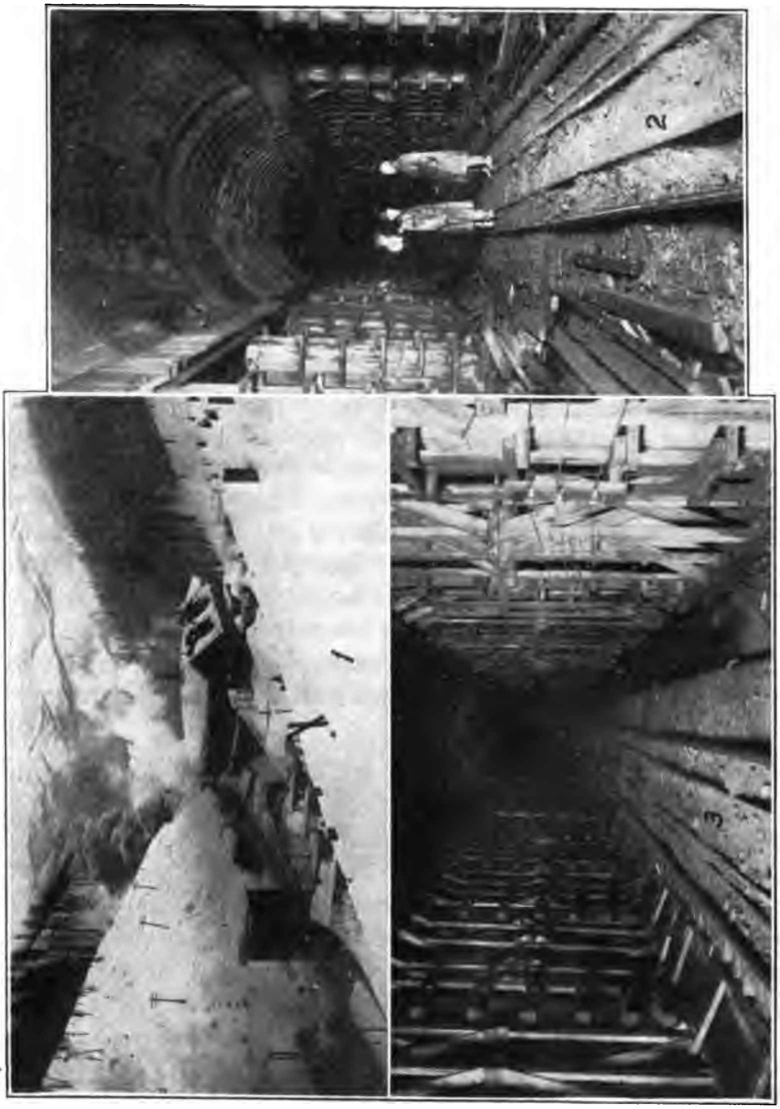
The topography adjacent to the west portal was bad, being on a steep mountain side and with an approach cut that materially hampered the installation of material handling equipment and caused many delays by being easily blocked with snow during the winter months. A birds-eye view of the west portal showing the narrow canyon approach to the tunnel and the cramped conditions of camp layout is shown in photographs Nos. 1 and 4. The west portal of the tunnel is about 400 ft. in an approach cut. The camp site was located over the side of a side-hill fill, making it necessary to support the camp buildings, bunk houses, dining room, etc., on bents, some exceeding 50 ft. in height. The power plant was located about 1,500 ft. from the portal and on the up-hill side of the tracks.

From the apex of the grade at the summit at about the center of the tunnel the grade sloped both ways on 0.2 per cent to each portal. The tunnel is on tangent except for 470 ft. of 10 deg. curve at the west end and a 10-deg. approach curve 244 ft. long through the snow shed at the east end. The tunnel is single track.

When the tunnel was driven in 1907-09 all except 1,300 ft., about a thousand feet from the west portal was timber-lined, full lagged and packed as there was considerable overbreak due to the fact that the slate lay on a 30-deg. dip to the horizontal and was interlined with water-bearing talc seams. During the intervening years some of the timber was displaced slightly by pressure from swelling ground and as the tunnel was very wet steps had to be taken to dry the roof to permit electrification. That primarily was the cause for starting the work, although a few years more would have made concrete lining necessary on account of the condition of the timbering. As the work progressed a close inspection was made of the untimbered section and it was decided to concrete the roof, supporting the arch on a system of columns and girders. The roof was concreted to prevent falls of small stones which were loosened by engine exhaust and fell, due to the dip of the formation described before.

There was a deposit of natural gravel suitable for concrete purposes within 100 miles, cement mills were located within 200 miles, and lumber within 100 miles. Owing to these facts and to the general convenience of handling these materials, a concrete lining was considered the most economical and permitted the greatest amount of speed in completing the work.

The original timbering was set for an 18-ft. 6-in. section and the concrete section was made 16 ft. 6 in. wide, allowing one foot in front of the timbers with three feet between the timber sets, which were on four foot centers. To strengthen the section at the connection with the footings a slight narrowing was made as shown on one of the drawings, which shows the sections used between Stations 9+C8 and 85+05. Due to the fact that some of the timbers were pressed towards the center slightly at both ends of the tunnel a section 18 ft. wide was used to prevent cutting the timber to excessive thinness and also to give a full foot in front of the timber. This section was used between the east portal and Station 9+08 and between the west portal and Station 85+05. As described above, the formation in the untimbered section permitted the fall of small stones and a roof section was all that was needed to prevent these falls. A full section, as shown above, would have taken considerable concrete, would have slowed up the completion of the work, and in addition would have added much to the total cost of the project. It was decided to construct a series of columns and reinforced concrete girders to support the



1. Looking West from West Portal of St. Paul Pass Tunnel.

2. Untimbered Section of St. Paul Pass Tunnel Showing Column and Girder Construction, Supporting Concrete Arch Roof.

3. Section of St. Paul Pass Tunnel Showing Concrete Forms.

roof. The limit loads on the columns and girders were considered as existing at the time the arch was completed and concrete green. After the concrete was set it was figured that the irregularities of the roof would furnish sufficient bearing to hold the load. Photographs Nos. 2 and 3 show columns, girders and arch in this section.

Difficulties Encountered

Traffic through the tunnel was heavy and although continuous operation was attempted the machines worked but 28 per cent of the time. All locomotives passing through the tunnel were oil-burning and much trouble was experienced and delays suffered, due to the fact that the tunnel did not clear well and the gas C. O. caused by incomplete combustion of the oil often caused a cessation of the work as the men were unable to stand up under the air conditions. The tunnel cleared well on clear days, air going to the east in the morning and to the west in the afternoon, this being caused by the sun striking and warming the air on the east slope in the morning and the west slope in the afternoon. During rain or snow storms the air would drift back and forth, following the movement of trains, but the tunnel would not clear entirely. A system of ventilation was tried out but with the power available, the effects were not noticeable beyond a thousand feet from the portals, and the results obtained cannot be considered satisfactory.

As described before the topography at the west portal was such that the plant was spread out and located on a side hill with little or no room for the storage of construction materials. A water supply was obtained from creeks running over the portals at both the east and west ends. The water was melted snow, especially suited for boiler and domestic purposes and sufficient pressure was obtained by building small dams some distances above the portals and conveying the water to the camps by pipe lines. Water for the mixers was obtained from the tunnel ditches and as there was a discharge of over a second foot there was always sufficient water available.

Light was furnished by a generator in the power house, 75 k.w. d. c. 500-volt with a split circuit so that the voltage in the tunnel and camps was 250. Considerable trouble was experienced in maintaining the lights in the tunnel due to short circuits caused by excessive water and to breaks caused by moving forms, etc. On clear days the lighting system, which consisted of 60-watt

lamps every 20 ft., was very effective, the usefulness being in direct ratio to the amount of smoke and steam in the tunnel.

Little or no time was lost due to crowding ground. Places that were crowding were bled in advance of the lining work and were considered as of regular section when the lining reached that point. The roof pressure between Stations 43+70 and 44+06 and between Stations 58+75 and 59+27 necessitated the removal of 47 sets of arch segment timbers and 33 extra side wall posts and the placing of 34 steel arches, each designed to fit its location from field measurements.

As the equipment was stored on sidings below the camp and men invariably rode the mixer trains in and out, not much time was lost due to going and coming from camp. Carpenters and helpers working on the forms used about 15 minutes on each of the in and out bound trips when walking. During the season of 1916-17 the last snow storm occurred on June 20 and the first on August 28, and during the month of February there was snow to the level height of 16 ft. around the camp and portals. This made it necessary to clear the tracks daily for the rotary plows, and to cut retreats in the snow banks to permit men to walk the tracks and have a place to get in the clear of trains. During the winter months it was often necessary to stop work on the tunnel and put all men to handling snow to free equipment and keep the road open for traffic.

All concrete material was bank run gravel from Frenchtown, Mont. Gravel loaded late in the season and covered by rain or snow in transit arrived at the tunnel in a frozen condition. It was thawed by steam points and transferred to a storage bin or pile, both of which had a system of steam pipes to keep the gravel warm. Regardless of this fact delays on account of the loading of frozen material were frequent. Temperature extremes were great, very dry and hot in the summer and cold with high winds and 30 deg. below zero in the winter.

Preparation of the Tunnel for Lining

In the rock section where no timbering was necessary and the roof was lined as previously stated, the standard section footing was used. The water was cut across the tunnel and the section cleared to rock. The forms were placed with column templates and concrete poured. The footing contained a gutter section. Where the tunnel was timbered the excavation was carried to rock

in front of the timbers and where possible the space back of the sill was cleaned. The forms were then set and concrete poured. In case of side pressure and struts, the footing was placed in small sections and the strut and footing sections poured together. Where there was a slight pressure but not considered sufficient to warrant struts, temporary timber struts were placed between the sills, the entire section was poured and the timber was cut off at the face of the footing when the concrete had set. The rock bottom was rough and there was sufficient bond between the concrete and the rock to prevent any slip of the footing after the concrete had set. Footings were built ahead of the rest of the work. The top of the footing was keyed and dowelled for the side walls and the part projecting beyond the face of the side wall was faced and made smooth to grade and was used for moving and placing the section forms. No inverts were considered necessary.

Method of Lining—Plant

About 300 ft. from the west portal and on the south side of the track there was placed a guy derrick with a 66-ft. boom. This operated across the main line, unloading gravel cars to the material bin located on a side track just north of the main line or to the gravel storage pile located on the side hill south of the track between the derrick and the portal. The clamshell bucket used with the guy derrick was of three-quarter yard capacity and could unload a maximum of 20 Haskell and Barker cars per day. The crew on this unloading outfit consisted of an engineer, who handled the clamshell bucket and the swinging of the boom with a Dake swinging gear, and two men in the cars who cleaned the cars as the unloading progressed. The material bin was built over the side track and at an elevation sufficiently high to permit of the passing of the hopper cars beneath it for loading, and also to permit the movement of ordinary box cars loaded with lumber and cement. The bin had a capacity of 200 cu. yds. with a hopper bottom sloping to two slide gate discharge openings. The sides of the bin were piped for steam heat and this was used during cold weather, steam being supplied by a hoisting engine boiler set up near the bin.

For concreting the footings and the side walls up to about 4 ft. above the spring line a mixer was designed in the Chicago office. This machine worked very successfully and it was possible to get material to the machine by attaching not over two hopper cars. The footing and side wall machine usually consisted of the

mixer and two hopper cars and as a rule there was not sufficient time between trains to use all of the material loaded. Cement was loaded on a car in front of the mixer from a storage house outside the tunnel during the time the outfit was outside waiting

4. View of the West Portal, St. Paul Pass Tunnel.

5. Side Wall Machine St. Paul Pass Tunnel Used for Concreting Footings and Side Walls.

for trains to pass through the tunnel. This machine, called the "side wall machine," is shown in photograph No. 5, one of the gravel hopper cars appearing at the left and the cement car at the right.

The arch was concreted by a high car built on the job. An ordinary mixer housed on a flat car with a hoist that carried the concrete to the top of the car where it was dumped and shoveled into the arch. Full section lagging was used up to the key when 3-foot sections were used and concrete rammed in place.

The Power Plants

The building housing the power plant at the west end at Roland, Idaho, was of wooden frame lined with sheet iron and erected from material used on a power house on Snoqualmie tunnel. Four 125 h.p. locomotive type oil burning boilers were installed together with four air compressors—2 Laidlow Dunn Gordon, duplex, each 1,030 cu. ft. per min.; 1 Ingersoll Rand straight line, 525 cu. ft. per min., and 1 75 k.w. Generator, D. C. 500 volt.

The power plant at the east end at East Portal, Montana, contained one 125 h.p. locomotive type oil burning boiler and one Ingersoll Rand straight line air compressor, with a capacity of 525 cu. ft. per min.

The plant was under continuous operation and caused little or no trouble; water conditions were ideal and the mechanical condition of the equipment was good throughout the work.

Pneumatic Mixing and Placing

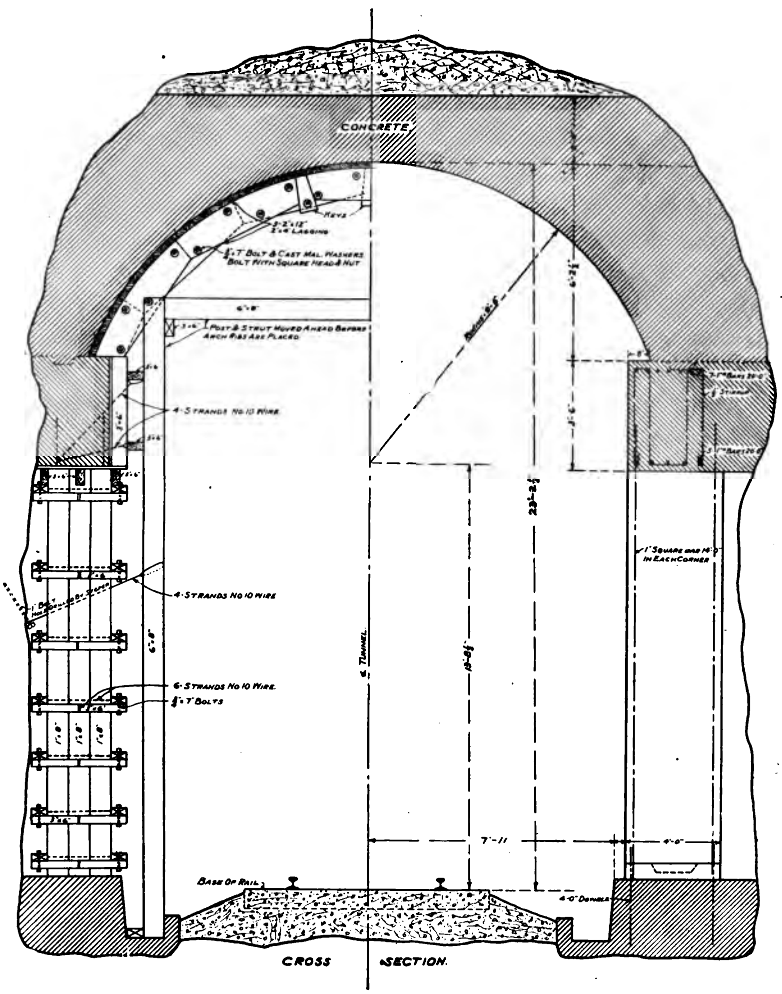
The lining of the tunnel at either end and of 1,300 ft. of the rock section of the arch was placed by air, a type-A pneumatic mixer, purchased from the Pneumatic Placing Company of New York, being used. This mixer was first located at the Roland end of the tunnel and after 1,074 ft. of the west end had been lined, it was removed to the east portal, from which set up 1,089.5 ft. of the east end was lined. The plant was located as near the portals as possible in both cases. After the ends had been lined this mixer was installed on a specially designed car, and used to concrete the arch in 1,300 ft. of rock section. The conveyor pipe was 8 in. in diameter, connected with 8-hole bolted flanges screwed to the pipe. This pipe was laid along the floor of the tunnel just inside the gutter line and was carried up to the roof and over to the center line of the tunnel by means of three short pieces of pipe and four 45-deg. elbows. These elbows were subject to a great deal of wear and it was necessary to renew them frequently. A great deal of difficulty was experienced with the elbow flanges. The impact of

the concrete against the elbow caused these flanges to crack, necessitating the use of extra heavy hydraulic flanges for the discharge pipe. A great deal of care was necessary in supporting and bracing the discharge pipe to the tunnel timbers. The plant serving the pneumatic mixer was very similar at both ends of the tunnel. It consisted of a gravity feed gravel bin, filled directly from cars by a clamshell operated from a stiff leg derrick. The gravel fed from the hopper directly into a measuring bin, in which the cement was added and from which it fed directly into the top of the pneumatic mixer by gravity. The water was added at the time the mixer was being filled. Care was necessary at all times to watch the gravel carefully for large sized stones. Anything over four inches was very liable to plug the pipe. This trouble was mainly overcome at the source by the installation of screens at the gravel pit at Frenchtown, Montana.

The fact that the pneumatic mixer discharged at the roof on the center line of the tunnel necessitated setting up and filling both the side wall and arch forms at one operation. It was occasionally impossible, however, to complete the filling of a form at one operation on account of the speed with which the concrete was discharged, causing the form to spring at about the spring line. When the form showed signs of springing, work was discontinued and connections were made at another form until the concrete in the first form had set sufficiently to allow the continuation of filling to completion. There were six complete sets of forms in use, with a discharge pipe for each form, which was connected and disconnected from the main supply pipe on the floor of the tunnel, which extended the full length of the portion being lined. This, of course, saved a great deal of delay, since when one form was completed, it was only necessary to disconnect the discharge pipe and make connection at another form. The discharge pipes were supported from the roof of the tunnel and moved ahead with each form.

Considerable experimenting was done with this mixer. The speed attained varied according to the distance. On one form located 700 ft. from the mixer a batch was shot at intervals of 1 min. and 47 sec. for a total time of 3 hr. and 20 min., this being at the rate of 13.45 cu. yd. per hour. On another form 13.22 cu. yds. were deposited per hour for 4 hr. and 45 min., or at the rate of a batch every minute and 49 seconds. At longer distances the speed was greatly lowered, however, under the first method used

whereby each batch was shot through to the form before another batch entered the pipe. At a distance of 1,000 ft. from the mixer, by this method of entirely clearing the pipe of the charge, it was necessary to hold the air on the mixer until the mixer dial dropped to 15 lb. This resulted in a large loss of air and took five or six minutes per batch, two minutes of which was required to blow the batch, thus reducing the air pressure to 65 lb., and three minutes to build up the air pressure to 105 lb. necessary for successful operation. By experimenting the method of not entirely clearing



Concrete Tunnel Lining, C. M. & St. P. Ry.
Arch supported by Concrete Beams on Concrete Pillars. Left side shows falsework in position. Right side, falsework removed.

the pipe of one batch before another was started was used successfully, resulting in a batch every two minutes at a distance of 1,000 ft. Of this 2 minutes, 40 seconds was required in blowing the batch, the mixer air dial dropping to 35 lb. while the main pressure dropped to only 85 or 90 lb. It then required 1 min. and 20 sec. to build up the air pressure to 105 lb. again ready for another shot.

The results obtained with the pneumatic mixer were very satisfactory, both when located at the portals and on the car. The concrete was very dense and it was possible to obtain a much more dense and impervious roof than when placed by hand. The most essential feature is the plant. There must be an abundance of air and storage capacity. The traffic delays with the pneumatic car, which were the only delays experienced, were much more than the combined delays of the mixer at the portals, amounting to about 78 per cent. in the former, as compared with about 60 per cent. in the latter. Of this 60 per cent. it will be noted that the greater part was on account of pipe delays.

Forms

Wooden forms were used throughout. The length of the section was 20 ft. The side wall forms carried the concrete to about 4 ft. above the spring line. The forms were braced strongly at the base by struts across the tunnel and against stakes driven into the ballast. They were tied to the tunnel timbering by means of wires connecting with butterflies to bolts in the form. The forms were moved ahead by means of steel rollers placed on the floor of the gutter. About four hours was consumed by five men in taking down, moving and setting up a pair of wooden forms. When forms were to be moved for a considerable distance in the tunnel a form moving car was used. The car was easily and quickly operated. The record time for moving one pair of forms for a distance of 4,000 ft. from the time the form moving car was spotted at the form with the locomotive attached, until the form was secured at the new location and the work train engine and car had cleared the tunnel was 35 min. A total of 16 forms were in use, spaced at convenient distances throughout the section of the tunnel, which was being lined at one time, usually about 400 ft. apart. The walls were poured to the top of the side wall forms 4 ft. above the spring line in advance of the arch which was placed and poured after the side wall concrete had set and the form moved, except where pneumatic mixer was used, where the side

walls and arch were both poured at the same time. The arch sections were 20 ft. long the same as the side wall sections. Generally 48 hours were allowed before the forms were broken loose, but in cases of need this was reduced occasionally to 18 hours. No trouble was experienced with the concrete sticking to the forms. In all cases, the side wall forms were moved as a unit, independently of the arch. The arch form was not moved as a unit but was collapsed and assembled at each set-up.

Grouting

The entire tunnel was grouted. The Ransome Canniffe grout mixer was used. Six of these machines were arranged in batteries of two to a car. The machines were installed on an ordinary flat car, one at each end, with material bins in the center. The sand was shipped from Beverly, Washington, and was sacked in cement sacks at the tunnel before being loaded into the car. The grouting was placed by compressed air at a pressure of 100 lb. per sq. in., received from the main line on the floor of the tunnel, tees being provided at proper intervals for connection to the mixer. Water was received in like manner from a water line which was carried the entire length of the tunnel. The air connections were made with 2-in. flexible air hose and 2-in. pipes with the lower end threaded for the grout pipe connection were placed in the arch at intervals varying from 4 ft. to 20 ft., depending upon conditions. Some of these pipes were placed in the form before the concrete was poured, but they were apt to become plugged or dislodged during the concreting, and for the greater part of the tunnel these pipes were placed after the concrete had set. The holes were drilled by an air drill and the pipes driven to position. A flexible 2-in. air hose connected the grout machine with the grout pipe in the roof of the tunnel. At the beginning of grouting the mixture used was one half sack of cement to one sack or 0.9 cubic feet of sand. This was later changed to one-third sack of cement to one sack of sand, equalling 30 batches per cubic yard. The total quantity of grout placed in the tunnel was 8,768 cu. yd., equalling 1.66 cu. yd. per lineal foot of tunnel exclusive of the rock section, in which it was only found necessary to place about 50 cu. yd. on account of the dryness and the density of the concrete which was placed by the pneumatic method.

There was a very great difference in the amount of grout placed in the different holes. When operations commenced at

a new location the grout ran each way from the hole, sometimes as far as 100 ft. The greatest number of batches shot in one hole before the refusal point was reached was 2,670, which equals 89 cu. yd. The usual quantity necessary to fill a hole to point of refusal, however, was between 15 and 20 cu. yd.

Below is a summary of the concrete yardage placed at different locations by the different machines for the entire job, amounting to a total of 39,271 cu. yd.

Summary

Power House Foundations	88
Gravel Bin Foundations	13
Footings, timbered section	4,511
Footings, rock section	990
Struts, Baffles and Drain	96
Side Walls	19,600
Arches	12,341
Rock section, columns	389
Rock section, girders	1,243
Total	39,271

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W. C. Harman, Chairman,
M. M. Corrigan,
James Gratto,
Geo. W. Rear,
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Committee.

AN ORGANIZATION FOR TUNNEL MAINTENANCE

From Railway Maintenance Engineer, August [illegible]

By George W. Andrews

The Baltimore & Ohio has on its lines a total of 150 tunnels with an aggregate length of approximately 23 miles. With such a number and mileage, it is not surprising that the road has developed a separate and distinct organization or tunnel forces to take charge of their proper maintenance. In addition to maintaining a separate force of workmen the road has assigned certain equipment exclusively to this particular class of work, while the tunnel forces are also permitted to draw on the general maintenance of way equipment whenever necessary.

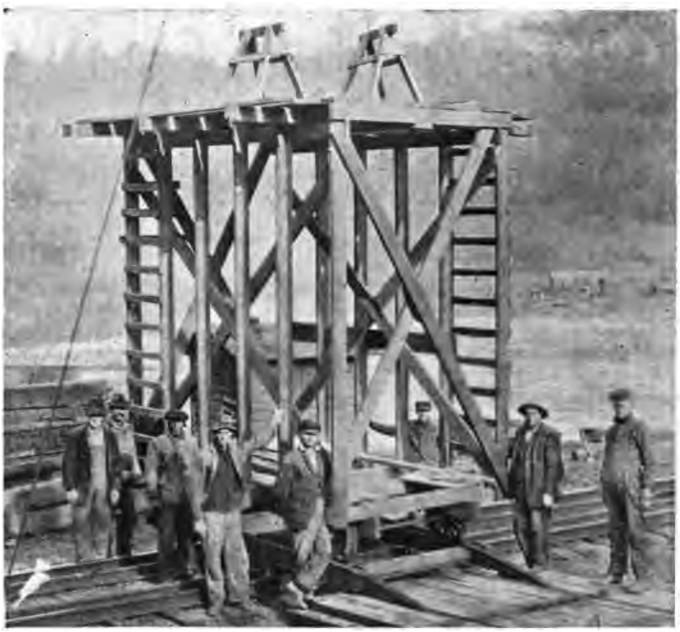
Ventilating Plant at the Eaton Tunnel, B. & O. R. R.

These 150 tunnels of the Baltimore & Ohio vary in length from a minimum of 100 ft. up to a maximum of 7,400 ft. Only four divisions on the road are entirely free from tunnels, while on the remainder the number varies with a maximum of 24 on the Monongah division. On the Parkersburgh branch of the Monongah division there are 23 tunnels in a stretch of 98 miles. On the Belt line in the city of Baltimore there are nine tunnels alone, one of

which being the longest on the road. This tunnel, 7,400 ft. in length, connects the Mount Royal station of this road with its Camden station, located on opposite sides of the main business center of the city. This tunnel is double track and passes under the most congested part of the city.

An Organization for the Entire System

The organization used in tunnel work is comparatively simple, consisting of a number of field gangs of from 12 to 25 men, each in charge of a skilled foreman and an assistant foreman, who work over the entire system. These foremen report to and receive their instructions from an inspector of tunnels, who maintains his headquarters at Baltimore, Md. He, in turn, reports to the assistant to the chief engineer maintenance, who, as head of this sub-department or tunnel organization, reports periodically to the chief engineer maintenance on expenditures for prospective work, on the results accomplished, etc. Each foreman keeps a record of the work upon which he is engaged, reporting regularly to the inspector of tunnels, who correlates the information so received into reports



Scaffold Car Used in Tunnel Work, B. & O. R. R.

to the assistant to the chief engineer maintenance. These reports are roughly classified into two forms, the first of which is a progress report for the month, showing in detail the amount of work which has been accomplished on each undertaking, the amount of material used, the cost and an outline of the work to be done in the next month, or, if the work in any particular tunnel can be com-

An Interesting Type of Centering as Used on the Baltimore & Ohio

pleted in less than a month, an outline of the work necessary to complete it. The second is a completion report, which is made shortly after a piece of tunnel work has been completed. This report shows in detail the location, the amount of material received and used, the labor required, the total amount of work done and the cost.

All work, in so far as possible, is carefully scheduled as a part of the annual budget of the maintenance of way department, although shown on that budget as separate expenditures for tunnel maintenance. The tunnel maintenance budget is prepared after a careful investigation of each tunnel on the system. Late in the fall the inspector of tunnels makes a trip over the lines and inspects personally every foot of each tunnel. From this inspection and the data that he has obtained relative to their condition he prepares a preliminary budget for the ensuing year. In this preliminary budget

each tunnel is dealt with separately and the material and labor costs are shown in detail. After this has been rechecked against the field notes it is submitted to the assistant to the chief engineer maintenance.

This officer in company with the inspector of tunnels then makes a personal inspection of each tunnel and decides in the field the relative importance of each piece of work. The preliminary budget is next corrected to correspond with the decisions thus made and the final budget made and submitted to the chief engineer maintenance. After the authority for expenditure has been made the work is carried out in the order of its relative importance as shown in the budget.

All Equipment Follows General Pooling Plan

A certain amount of equipment is assigned permanently to each gang. As they are floating forces they have their own bunk cars, a kitchen car, a mess car and one or more tool and material cars. Generally, each layout includes a box car, a gondola or some other type of open-top car, a large capacity push car or trailer and a hand car. In many cases the equipment includes a motor car.

Such other equipment as is not used regularly on each piece of work is pooled, the different tunnel gangs drawing on the pool for various pieces, as they are found necessary. In this class of equipment are included cement guns, hoisting engines, steam and gasoline-driven pumps, pulsometers, grout pumps, motor cars, etc. Other classes of equipment not regularly used by the tunnel organization, but in more or less regular use by the maintenance of way department is drawn as needed. In this class are included concrete mixers, derricks, locomotive cranes and other miscellaneous heavy equipment.

In order to facilitate the distribution of all equipment regular statements are prepared on each division and forwarded to the main office at Baltimore, showing the location of each piece, its condition, its capacity and whether in use or not. Thus the officer in charge of tunnel work can quickly arrange for and collect the equipment necessary for any particular piece of work. All materials for the work are likewise handled through the main office, their purchase and delivery being under the direction of the head of the tunnel organization.

Alterations and Changes Performed Under Traffic

Covering a period of over 26 years the Baltimore & Ohio has

made alterations and extensions, exclusive of normal maintenance and repairs, on a total length of tunnels approximating [illegible] miles of the [illegible] miles of tunnel construction. This work has entailed a large amount of reconstruction necessary to obtain increased clearances and in many instances in changing from single to double track.

With but two exceptions all tunnel work has been carried on under traffic and the tunnel organization of this road has not yet had a personal injury among its employees that has cost the road any money. In general the alterations have, in addition to securing increased clearances where necessary, consisted in relining the tunnels with brick, this material having been found to be one of the most satisfactory for the purpose.

In working under traffic a complete telephone system is installed with phones at each portal and at the location of the work. The foreman remains at or close to the telephone in the tunnel and receives all messages regarding approaching trains. He is thus given sufficient time to take ample precautions for the safety of his men. The work of relining or for that matter any work on the tunnel roof is carried on from platforms and in some cases from movable scaffolds. Usually hinged platforms are used which can be dropped to clear any passing trains. These platforms are about two feet wide and run for varying lengths along the wall of the tunnel. They are supported by being hinged to a timber bolted to the side wall and held up in working position by brackets fastened to the wall and also pivoted to swing clear of trains. Where the entire roof is to be worked over frame work is installed on each wall and forms or centers laid across from one side to the other. In many cases a scaffold is mounted upon the trucks of a heavy trailer. This is pulled in and out of the tunnel as needed, by means of a motor car, which is also used for transporting material in and out as needed.

The Use of Concrete in Tunnel Repairs

While the greater proportion of the lining of reconstructed or enlarged tunnels has been of brick, concrete has been used to good advantage in numerous instances. This is especially true where fires or other conditions have destroyed parts of the existing lining or where the lining has deteriorated so much as to be unserviceable or unsafe. Where it is not desirable to rebuild such tunnels because of prospective changes in design or size they are repaired with gunite, using a cement gun. In order to secure uniformly high

grade work, this equipment is assigned to a regular operator, who maintains and directs its use as called for. In many cases it has been found possible to prolong the life of an old tunnel lining by grouting in behind it. In this work the grout pumps are usually placed in the clear and the grouting pumped through pipes driven through the tunnel walls. Where it is possible and economical the condition is reversed and pipes are driven in from the outside. While it has been stated that the tunnel organization conducts its work independently of the other branches of the maintenance of way department there is a partial exception to the rule here, as all grouting, whether in tunnel work or in bridge and building work is performed by the workmen in the tunnel organization.

Whenever it is necessary to completely reline a tunnel or where it is necessary to rebuild it because of limiting clearances the new work is made to conform to Baltimore & Ohio standards. These standards call for a total width of 30 ft. between side walls of a double track tunnel and 18 ft. for single track and clearances of 23 ft. and 21 ft., respectively. Where brick is employed, five rings are used in the double track arches and four in the single track, backed in each case by concrete. Elevation markers are set in the side walls, indicating the maximum height to which the tracks may be raised throughout the length of the tunnel. Safety niches are constructed in the sidewalls 100 ft. apart and staggered. Drainage is provided by means of two lines of pipes in most installations and by three lines where conditions are such as to render this necessary.

DISCUSSION

Secretary Lichty:—Volumes could be written on this subject from the experience of our members but it is too extensive to elaborate on during the few hours we have in convention for discussion. The paper is well prepared and a number of the more modern methods are ably described in the report. The technical journals have, from time to time, described and illustrated the work done on various roads throughout the country, prominent among which are the Baltimore and Ohio, the Southern Pacific, the Virginian, the Carolina, Clinchfield and Ohio, the Louisville and Nashville and the Southern.

The Southern Pacific and the Baltimore and Ohio have done a great deal of this work recently and some of the members are here

who have had direct charge of it. They may be able to mention some interesting points in connection with their experience.

A. Fraser (Sou. Pac.):—I do not know that I can add much of interest on the subject as the great amount of work which was done on our road during the past five years is well covered in the report, the chairman of the committee being from our line and directly connected with the work. We have done a great deal of tunnel lining during the past 4 or 5 years under all sorts of conditions. Besides bad weather at times, and heavy traffic, war conditions made the work difficult and expensive. The work was new to us and our methods were developed by experiment. We experienced a great deal of trouble with the pipe lines which carried the concrete by air pressure. The joints and elbows wear rapidly and the necessary repairs caused serious delays. The gas engine for the air compressor was not reliable and it caused more or less trouble. There is very heavy traffic on our road where we worked in the tunnels and the heat and smoke were unbearable at times. In fact the ventilation was bad most of the time.

President Strouse:—I have before me a description of the method employed by the Baltimore & Ohio in lining tunnels, prepared some time before the committee formulated its report. I would like to have Mr. Andrews make a few remarks with the idea of adding this article to the report.

G. W. Andrews:—The Railway Maintenance Engineer for August of this year (1921) contains an article entitled "An organization for Tunnel Maintenance" which I am going to offer as a part of my discussion on tunnel organization and the lining of tunnels under traffic. This data was turned over by myself to Mr. Moore, one of the editors of the above named paper, who prepared the article, using very nearly the words of our conversation. This article is well worth the reading and the study of every railroad man having anything to do with the maintenance of tunnels.

The bulk of the work that is done in tunnels is under traffic, as you know. The Baltimore & Ohio has 150 tunnels ranging from 100 ft. up to 7,400 ft. in length, the latter being at Baltimore and was constructed in 1885. We pumped grout in there for two years. We did one-half of it by working in the tunnel and the other half by working from the surface through drilled holes. That work would furnish a paper in itself and I am unable to enter into a discussion of it in the brief space of time that is allotted here.

The total length of our tunnels runs very close to 28 miles. In the 26 years that we have had this special tunnel organization in effect we have rebuilt over 8 miles of the total. Many of the tunnels which were rebuilt were originally lined with timber or had no lining, while others were rebuilt for double track. This work was done under traffic without serious injury to a single man employed on the work until lately when a young man was killed in a tunnel at Pittsburgh. I have had personal direction of this work for a period of 23 years, and the success we have had and the immense amount of the work we have done and are still doing, makes me naturally feel that we have an organization that is well worth the consideration of every railroad in the country having extensive tunnel operation.

Pneumatic Concreting Plant, Southern Pacific Co.

Tunnel No. 6, Tehachapi Pass, Cal., Southern Pacific Co.
Left: Steel Forms and Reinforcing Steel in Place in Uncompleted Section.
Right: Steel Forms in Place and Completed Section.

Steel Forms in Process of Erection Prior to Being Rolled into Tunnel, Southern Pacific Co.

Tunnel No. 10, Tehacapi Pass, Cal., Showing 6-in. Discharge Pipe Rising from Ground to Top of Forms


Lining Tunnel Under Traffic

TOOL EQUIPMENT FOR PILE DRIVER OUTFITS

REPORT OF COMMITTEE

This subject is in a way supplementary to one previously reported on, under the subject "Modern Methods of Driving Piles," and we wish to refer to the report of the committee on that subject as published in the Proceedings of 1916.

It was considered impracticable to hold a meeting of the committee, and the subject was therefore handled entirely by correspondence. In addition to information furnished by members of the committee, recommendations for tool equipment were received from B. L. Johnson, Spokane, Wash., and E. A. Mills, St. Paul, Minn., general master carpenters on the Great Northern.

The committee started out with the idea of preparing lists of tool equipment for the various classes of drivers, namely, track, marine and land drivers. Land drivers were eliminated, as they were considered special and would be fitted up to meet the special conditions under which they were intended to be used, and in any event the tool equipment would conform closely to that required for track drivers. The tool equipment for marine drivers also are largely duplicated in track drivers and no separate list has been worked up. (For a detailed description of a floating pile driver and equipment, see Appendix B, by G. W. Andrews, covering equipment used on the Baltimore & Ohio).

Track drivers should be equipped with a self-propellor, capable of a speed of 25 miles per hour; swinging leads to drive batter piles; a follower cap and followers; drop hammers of about 2,500 lbs., and 4,500 lbs. or a steam hammer of about 30-inch stroke; an air pump and air reservoir capable of furnishing air for two air hammers or air boring machines; a dynamo for an electric headlight; carbide lights for emergency work; and with pump and equipment for jetting piles. (For a detailed description of methods and equipment for jetting piles, see Appendix A, by R. C. Young, covering its use by the Lake Superior & Ishpeming Ry.

Tool Equipment for Track Pile Driver

1 Tool car equipped with work bench, bins for bolts, spikes, and washers, racks for bars, saws, augers, jacks, shovels, etc.; also lockers for small tools and parts.
1 Combination bench and pipe vise.
1 Anvil.

1 Small forge and set of blacksmith tools.
1 Small drillpress and set of 1/4 in. to 1 in. drills.
1 Set of pipe stocks and 1/2 in. to 1 1/2 in. dies.
1 Set of bolt stocks and 3/8 in. to 1 1/4 in. dies.
1 Pipe cutter, 1/2 in. to 2 in.
2 Pipe wrenches, 18 in.
2 Pipe wrenches, 24 in.
2 Monkey wrenches, 18 in.
2 Ball pean machinist hammers.
1 Hack saw and 12 blades.
6 Double cut 16 in. files.
2 Double cut 16 in., half round files.
2 Hand cold chisels.
2 Hand saws, 1 cross cut, 1 rip.

Track Tools

1 Motor car.
1 Push car.
1 Track level.
2 Track gages.
3 Track wrenches.
6 Track shovels, No. 2.
3 Spike mauls.
2 Track chisels.
2 Track jacks.
2 Claw bars.
4 Picks.
2 Track adzes.
3 Track tampers.
1 Grind stone and frame.

Bridge Carpenter Tools

6 Cross cut saws 5 ft. long.
1 Saw clamp.
12 Saw files.
6 Axes, double bitted with handles.
6 Axe handles.
3 Hand axes with handles.
3 Adzes with handles.
4 Wrenches for 3/4 in. bolts.
3 Monkey wrenches, 18 in.
3 Chisel bars, 1 1/8 in. by 3 in.
3 Crow bars, 1 1/4 in. by 5 ft.
3 Lining bars.
2 5/8 in. ship augers with double cranks.
4 13/16 in. ship augers with double cranks.
4 15/16 in. ship augers with double cranks.
4 Lug hooks.
6 Cant hooks.
6 Peavies.
2 Timber tongs.
6 Claw hammers.
2 Sledges, 16 lb. with handles.
1 Motor driven circular saw.

Miscellaneous Tools and Equipment

1 Set of 4 sheave blocks 3 1/2 in. by 12 in. by 30 in.
1 Set of 2 sheave blocks 2 1/2 in. by 8 in. by 20 in.
1 Snatch block 2 1/2 in. by 6 in. by 16 in.
1 Snatch block 3 in. by 9 in. by 16 in.
1 Complete duplicate set of ropes, and cables used on driver.
1 Manila rope 3/4 in.—200 ft.
1 Manila rope 1 1/4 in.—500 ft.
1 Manila rope 1 1/2 in.—1000 ft.

1 Pile chain 2 in. diameter, 7 in. by 11 in. links—12 ft. long.
1 Pile chain 1⅛ in. diameter, 5 in. by 7 in. links—12 ft. long.
1 Pile chain ⅝ in. diameter, 2½ in. by 4 in. links—7 ft. long.
6 Long handled shovels.
4 25-ton hydraulic jacks.
4 Screw jacks, 24 in.
4 Screw jacks, 12 in.
2 Steamboat ratchets or pulling jacks, 30 in. screw.
4 Jack chains, ¾ in. by 6 ft., ring on one end and grab hook on other end.
1 Steam hose 50 ft.
1 Air hose—100 ft.
1 Water hose ¾ in.—100 ft.
3 Pike poles 2 in. by 16 ft.
1 Steel cable ¾ in. by 400 ft.
3 5-gal. oil cans.
6 12-qt. water pails.
1 Set flagging equipment to conform with standard rules; lanterns, flags, torpedoes, fuses, etc.

J. A. Bohland, Chairman,
G. W. Andrews,
T. W. Bratten,
A. J. Catchot,
W. R. Gantz,
Maro Johnson,
G. W. Land,
K. Peabody,
R. C. Young,
Harry James,
Committee.

APPENDIX A

Jetting Piles

By R. C. Young

In general, the method of driving piles by using a water jet as an auxiliary has been found to be very successful and is almost a necessity in what is known as marine driving, or in any location where the piles are driven in the water. It is more necessary where piles are driven to a greater depth than could be done with a hammer alone, to allow for future dredging of the harbor. This method of driving piles is more successful in sandy material, although it can be used where considerable clay soil is present. It is also by far the best method of putting down sheet piles in the water. The outfit to be used should be mounted upon a scow of suitable size, having a pump capable of delivering at least 400 gal. of water per minute. The jet should be made of 2½-in. pipe, long enough to reach the bottom of the longest pile. It should have a nozzle of about 1¼-in. in diameter, although good jetting can be done in sand to a depth of 20 ft. with a nozzle as small as ⅞-in., using a correspondingly smaller pump, provided the larger sized

pump is not available. This machine should be equipped with drums or winches enough to operate the hammer line, pile line and jet line at the same time. It should also be equipped with one steam capstan on each side of the scow to insure quick moving. This machine should be able to drive an average of 10 piles, 30 ft. to 45 ft. long, per hour with a penetration of 15 ft. to 30 ft. in sand.

The following is a description of an apparatus used by the Lake Superior and Ishpeming for dredging, driving piles, pulling piles and other miscellaneous work in the harbor. In the spring of 1918 this road built two scows from timber resawed from an old dismantled wooden ore dock, at a total cost of $3,130. One scow was designed to carry an "American ditcher." It is 22 ft. 6 in. wide, by 50 ft. long and 6 ft. 6 in. deep. The other scow is a dump scow 16 ft. 6 in. wide by 30 ft. long and 5 ft. 9 in. deep, with a capacity of 30 cu. yds. of earth. It was made light so it could be towed by an ordinary fishing launch, propelled by a 10 hp. to 15 hp. gasoline engine.

The outfit is capable of handling about 300 cu. yds. on a half mile haul in an 8-hr. day, with 4 men. If a much longer haul is necessary, two dump scows will be needed. This apparatus is very convenient in picking up shoal spots around a harbor, because it will work to the full depth close to the dock fenders, which cannot be done with a dipper dredge, and because it will move the material at a less price per yard in cleaning up shoal spots and is always available when needed.

Early in 1921 the Lake Superior & Ishpeming was obliged to drive three 30-pile clumps of protection piles at the end of its concrete ore dock. These piles were Oregon fir, 50 ft. long with 10 in. top and were driven in 22 ft. of water, 19 ft. into the sand bottom. The American ditcher was mounted upon the scow, which was fitted with 32-ft. rigid leads attached to the end of the boom. A 2,200-lb. drop hammer and follower was used.

A 6-in. by 8-in. duplex pump was installed. The pump was rather small, but the boiler would not furnish steam for a much larger pump. The jet pipe was 2 in. in diameter and 40 ft. long, with a ⅞-in. nozzle which was as large as the pump would furnish water for. A small gasoline hoist was installed on the scow to furnish power to handle the water jet. This rig was operated by a crew of 8 men and should be able to drive an average of 6 piles an hour in ordinary work.

In driving these clumps only 4 piles an hour were driven, the delay being caused by the difficulty in getting the piles close enough together. After this work was finished the crew started to pull the old piles from ore dock No. 1. These piles were 45 ft. long, cut off 1 ft. above the water and penetrated 25 ft. into the ground. There was some clay mixed with the sand bottom at this point and it was found that the pump did not have quite capacity enough to do the work economically, only 2 to 4 piles an hour being pulled, but later, where the piles were 35 to 40 ft. long, the outfit was able to average about 7 piles an hour. The scow was rigged up with two single blocks, so that a pulling strain of about 30 tons could be given to the pile while jetting. Five men were employed in pulling piles. The timber recovered is Norway pine and perfectly sound. A part of it was sold to the mines for trestle legs and the balance will be sawed into flat car decking with a portable sawmill. The work was in charge of August Anderson, a member of this Association.

APPENDIX B

Pile Drivers and Equipment

By Geo. W. Andrews

Exhibit A shows a photograph and a statement of the equipment of pile driver owned and operated by the Baltimore & Ohio in and around the harbor of New York City. Exhibits B and C show two floating drivers owned by a contracting company now doing a large amount of work for the Baltimore & Ohio in and around New York City. These machines are typical of the type used in this section of the country and will, it is believed, meet all requirements where the driving of piles from water is required.

The machine shown in Exhibit D is equipped with both an ordinary drop hammer and a steam hammer. The latter, however, is only used where a large number of piling are to be driven in groups. It is not found economical for the ordinary work of repairs around wharves and docks, but is useful for such work as shown in the photograph of pile drivers shown in Exhibit B.

The equipment on jetting piles, shown in Exhibit D, has been used in this territory for many years, both for driving concrete and timber piling. The weight of the hammer is kept on the pile while the jet is charged from the bottom of the piling. Occasional

[illegible]

EXHIBIT A

[illegible]

[illegible]

Dimensions

[illegible]

Equipment

[illegible]

Steam siphon (one on forward and one on back of scow), 2.
Air reservoir, 2 ft. 6 in. by 5 ft., 1.
Automatic air machine No. 5, 1.
½ in. to 1¼ in. auger bits, 2 sets.
4½ in. caulking auger, 1.
3½ in. caulking auger, 1.
Grind stone, 1.
10 in. emery wheel, Keystone, 1.
¾ in. air hose, 4 lengths.

Supplies

14 ft. yawl boat, 1.
Iron purchase fall for ¾ in. wire cable, 1.
10 in. wooden snatch blocks, 4.
14 in. iron snatch blocks, 2.
6 in. double block and fall, 1.
8 lb. double block and fall, 1.
8 lb. double ended mauls, 6.
10 lb. double ended mauls, 2.
Anvil, 1
Forge, 1.
Blacksmith tools, 1 set.
¾ to 1½ in. dies and taps, 1 set.
28 in. screw clamps, 1.
32 in. screw clamps, 1.
12 in. screw jacks, 2.
5 ft. steamboat ratchets, 2.
¾ in. to 3½ in. wrenches, 6.
150 lb. anchors, 2.
¾ in. cable for purchase fall, 200 ft.
Hack saw frames for 14 in. blade, 2.
1¼ in. by 6 ft. pinch bars, 6.
Chisel bars, 2.
50 ft. lengths ¾ in. water hose, 2.
6 ft. wire rope slings, 4.
Double chains, 8 ft. long of ½ in. iron and 3½ in. link, 12.
5 ft. cross cut saws, 6.
Boat hooks, 16 ft., 2.
Cant hooks, 10.
Combination vise, 1.

EXHIBIT B

General Contracting and Engineering Company

Dimensions and Equipment of Pile Driver No. 2

Size of scow, 24 ft. by 47 ft. 8 in. by 6 ft.
Height of leaders, 54 ft.
Width of leaders, 25 in.
Weight of hammer, 3,000 lb.
Capacity of water tanks, 6,500 gal.
Capacity of coal bunkers, 6 tons.
Lidgerwood boiler, 20 h. p.
Size of cylinders, 7 in. by 10 in.
Number of drums, 2.
Number of gypsies, 2 inside, 2 outside.
Size of water pump, 7½ in. by 5 in. by 6 in., Worthington.
Length of hammer fall, 135 ft., 4 strand plumbago laid.
Length of pile fall, 200 ft., ¾ in. durable wire rope.
Width of house, 15 ft. 0 in.
Length of house, 22 ft. 6 in.

Height to eaves, 8 ft. 10 in.
Height to ridge, 13 ft. 0 in.
Stern deck, 8 ft. 0 in.
Side deck, 4 ft. 6 in.
House to bed frame, 1 ft. 10 in.
Bed frame, 16 ft. 3 in., out to out.
Forward deck, 16 ft. 6 in., house to bow.
Length of engine, 10 ft. 10 in.
Width of engine, 6 ft. 6 in.
Anchors, 2, 1—200 lb., 1—300 lb.
Anvil, 1—100 lb.
Augers, crank—4—½ in., 5—¾ in., 6—⅞ in., 8—1 in., 4—1⅛ in., 4—1¼ in., 2—1½ in., 2—1⅝ in., 2—1¾ in., 2—2 in.
Augers, 6—¾ in., 4—⅞ in., 4—1 in., 6—1⅛ in., 2—1¼ in.
Augers, caulking, 2—3 in., 1—3½ in.
Bars, pinch, 6.
Bars, slice, 3.
Bars, roller, 6.
Bars, shackle, 4.
Blocks, single sheave, wood, 2—8 in., 2—10 in., 2—12 in.
Blocks, single sheave, iron, 2—6 in., 3—8 in., 2—10 in., 3—12 in.
Blocks, double sheave, wood, 2—6 in., 2—8 in., 2—9 in.
Blocks, double sheave, iron, 4—10 in., 2—12 in.
Blocks, triple sheave, wood, 2—12 in., 2—14 in.
Blocks, triple sheave, iron, 2—10 in., 2—14 in.
Blocks, quadruple sheave, iron, 2—12 in.
Blocks, snatch blocks, iron, 2—10 in., 2—12 in.
Booms, 1—40 ft. complete with pine, bands and gooseneck.
Cant hooks, 22.
Chains, sling, ⅜ in., 4—8 ft., 2—10 ft., 2—12 ft., 1—14 ft.
Chains, sling, ½ in., 2—10 ft., 3—12 ft., 3—14 ft.
Chains, sling, ⅝ in., 2—8 ft., 3—10 ft., 3—15 ft.
Chains, sling, ¾ in., 1—12 ft., 2—14 ft.
Chains, dogood, ½ in., 10—8 ft.
Chains, pile fall, ¾ in., 2—15 ft.
Chains, bull, 1½ in., 2—18 ft.
Cutters, cold, 10.
Dies, bolt, 1 set ¾ in. to 1⅞ in.
Dies, pipe, 1 set ½ in. to 1½ in.
Drills, 1 ratchet drill complete with drills ⅜ in. to 1 in.
Drills, 2—1 in. star drills.
Drills, 6—1 in. bull points.
Electric drill, 1—1½ in.
Forge, 1 hand.
Grindstone, 1—20 in. by 4 in. complete with stand.
Guns, electric, 1 B. & D. complete with 300 ft. wire.
Hammers, 4—8 lb., 4—12 lb.
Hooks, ripping, 5.
Hooks, pile, 1.
Hooks, timber, 2.
Hose, fire, 200 ft. 3 in.
Hose, water, 175 ft. 1 in.
Jacks, screw, 2—12 in., 2—14 in., 4—16 in.
Jacks, track, 2.
Lanterns, 6 red, 6 white.
Medicine chest, 1 Johnson & Johnson complete, No. 10.
Pails, 2—3 gal. water.
Pipe, 40 ft. ¾ in., 50 ft. 1 in., 50 ft. 1½ in., 50 ft. 2 in.
Poles, pike, 6—16 ft.
Pullers, ring, 2.
Rings, pile 2/14 in., 6/16 in., 4/18 in., 4/20 in., 6/22 in., 2/24 in., 2/26 in.
Roller, buggies, 4.

Rope, manila, 250 ft. ½ in., dia., 300 ft. ¾ in. dia., 500 ft. 1⅛ in., dia., 1,100 ft. 1¼ in. dia.
Rope, wire, 600 ft. ⅝ in. dia., 500 ft. ¾ in. dia.
Saws, cross cut, 12.
Saws, hack, 1—10 in., 1—12 in.
Screws, clamp, 2/22 in., 4/24 in., 2/30 in., 1/40 in.
Shackles, ¾ in., 2—5 in., 2—6 in., 2—8 in.
Shackles, 1 in., 2—6 in., 2—8 in.
Shovels, 6 round point, 6 square point.
Spikes, hand, 8/12 ft.
Tools, blacksmith, 1 complete set.
Tools, firing, 1 complete set.
Torch, 1 gasoline blow.
Turnbuckles, 2/4 ft., 2/6 ft.
Vise, 1—6 in. combination.
Wrench, chain, 1—24 in.
Wrench, socket, 2—1 in., 1—1½ in., 1—2 in.
Wrench, spikes, 12—¾ in., 6—⅞ in., 10—1 in., 6—1¼ in.
1 boat, 20 ft. by 4 ft. by 3 ft. complete with 12 ft. oar.

Machine Must Carry at All Times

1	pyrene fire extinguisher,	½	keg 60d spikes,
5	gal. machine oil,	1	saw rack,
5	gal. cylinder oil,	1	saw set,
5	gal. kerosene,	6	gauge glasses,
20	lb. waste,	12	miscellaneous valve discs,
2	mill brooms,	12	8 in. mill files,
2	mops,	6	6 in. auger files,
5	lb. washing soda,	1	12 ft. oar,
	can brass polish,	2	4 in. paint brushes,
2	gal. gray paint,	20	lb. oakum,
2	gal. white paint,	20	lb. cotton.
1	keg ⅜ in. by 8 in. spikes,		

EXHIBIT C

General Contracting and Engineering Company

Dimensions and Equipment of Pile Driver No. 1

Size of scow, 24 ft. by 55 ft. by 6 ft.
Height of leaders, 66 ft.
Width of leaders, 25 in.
Size of house, 15 ft. 2 in. by 24 ft. 0 in.
Weight of hammer, 3,600 lb.
Capacity of water tanks, 10,000 gal.
Capacity of coal bunkers, 7 tons.
Lidgerwood boiler, 35 h. p.
Size of cylinders, 9 in. by 10 in.
Number of drums, 2.
Size of air compressor, 9½ in. by 9 in. by 10 in., Westinghouse.
Length of hammer fall, 165 ft., 4 strand plumbago laid.
Length of pile fall, 250 ft., ¾ in. durable wire rope.
Width of house, 15 ft. 2 in.
Length of house, 24 ft. 0 in.
Height to eaves, 9 ft. 10 in.
Height to ridge, 14 ft. 0 in.
Stern deck, 10 ft. 3 in.
Side deck, 4 ft. 4 in.
House to bedframe, 4 ft. 8 in.
Bedframe, 17 ft. 4 in., out to out.
Forward deck, 18 ft. 9 in., house to bow.

Length of engine, 11 ft. 6 in., overall.
Width of engine, 7 ft. 3 in., overall.
Anchors, 2, 1—250 lb., 1—400 lb.
Anvil, 100 lb.
Augers, crank, 2—5/8 in., 6—3/4 in., 5—7/8 in., 6—1 in., 7—1 1/8 in., 4—1 1/2 in., 1—1 5/8 in., 3—1 3/4 in., 1—2 in.
Augers, air gun, 6—3/4 in., 4—7/8 in., 8—1 in., 5—1 1/8 in., 2—1 1/4 in.
Augers, calking, 1—3 in., 1—3 1/2 in., 1—4 in.
Bars, claw, 3.
Bars, pinch, 6.
Bars, slice, 4.
Bars, roller, 4.
Bars, shackle, 3.
Blocks, single sheave, wood, 2/10 in., 3/12 in., 2/14 in.
Blocks, single sheave, iron, 4/8 in., 4/10 in.
Blocks, double sheave, wood, 4/6 in., 2/8 in.
Blocks, double sheave, iron, 4/10 in., 4/14 in.
Blocks, triple sheave, wood, 2/14 in., 2/16 in.
Blocks, triple sheave, iron, 2/14 in., 2/16 in.
Blocks, quadruple iron, 2/14 in.
Booms, 1 50 ft. complete with pin, bands and gooseneck.
Cant hooks, 26.
Chains, sling, 3/8 in., 4—10 ft., 1—12 ft., 1—16 ft.
Chains, sling, 1/2 in., 6—12 ft., 1—15 ft.
Chains, sling, 5/8 in., 2—10 ft., 3—15 ft., 1—18 ft.
Chains, sling, 3/4 in., 1—14 ft,. 1—16 ft.
Chains, dogood, 1/2 in., 12—10 ft.
Chains, pile fall, 3/4 in., 2—15 ft.
Chains, bull, 2 in., 1—20 ft.
Cutters, cold, 8.
Dies, bolt, 1 set 1/2 in. to 1 3/4 in.
Dies, pipe, 1 set 1/2 in. to 2 in.
Drills, 1 ratchet drill complete with drills 1/2 in. to 1 in.
Drills, 2—1 in. bull points 4 ft.
Drills, 4—1 1/2 in. star drills 4 ft.
Forge, 1 hand.
Grindstone, 1—28 in. by 4 in. complete with stand.
Guns, air, 2 No. 6 little giants, 1 No. 4 little giant.
Hammers, 8—8 lb., 5—12 lb.
Hooks, ripping, 5.
Hooks, pile, 2.
Hooks, timber, 2.
Hose, air, 500 ft. 1 in.
Hose, fire, 150 ft. 3 in.
Hose, water, 150 ft. 1 in.
Jacks, screw, 2—14 in., 6—16 in.
Jacks, track, 1.
Lanterns, 8 red, 6 white.
Medicine chest, 1 Johnson & Johnson No. 10 complete.
Pails, 2—3 gal. water.
Pipe, 30—3/4 in. by 60 ft. 1 in., 60 ft. 1 1/2 in.
Poles, pike, 8—16 ft.
Pullers, ring, 2.
Rings, pile, 2—12 in., 5—14 in., 8—16 in., 8—18 in., 6—20 in., 6—22 in., 2—24 in., 2—26 in., 1—28 in.
Rope, manila, 200 ft. 1/2 in. dia., 250 ft. 3/4 in. dia., 600 ft. 1 in. dia., 500 ft. 1 1/4 in. dia., 1,200 ft. 1 1/2 in. dia.
Roller buggy, 4.
Rope, wire, 800 ft. 5/8 in. dia., 400 ft. 3/4 in. dia., 150 ft. 1 in. dia.
Saws, crosscut, 12.
Saws, hack, 2—12 in.
Screws, clamp, 2—24 in., 2—30 in., 1—36 in.

Shackles, 4—6 in., 4—8 in., 2—10 in., 1—12 in.
Shovels, 6 round point, 6 square point.
Spikes, hand, 8—12 ft.
Tools, blacksmith, 1 complete set.
Tools, firing, 1 complete set.
Turnbuckles, 2—4 ft., 2—5 ft., 1—6 ft.
Vise, 1—6 in. combination.
Wrenches, chain, 1—20 in.
Wrenches, socket, 2—1 in., 2—1½ in., 2—2 in.
Wrenches, spike, 6—¾ in., 6—1 in., 6—1½ in.
Boat, 1—20 ft. by 4 ft. by 3 ft. complete with 1—12 ft. oar.

Machine Must Carry at All Times

1	pyrene fire extinguisher	20	lb. oakum,
5	gal. machine oil,	10	lb. cotton,
5	gal. cylinder oil,	1	keg ⅜ in. by 8 in. spikes,
5	gal. kerosene,	½	keg 60d spikes,
20	lb. waste,	1	saw rack,
2	mill brooms,	1	saw set,
2	mops,	6	gauge glasses,
5	lb. washing soda,	12	miscellaneous valve discs,
	can brass polish,	12	8 in. mill files,
2	gal. gray paint,	6	6 in. auger files,
2	gal. white paint,	1	12 ft. oar.
2	4 in. paint brushes,		

DISCUSSION

G. W. Andrews:—I offered my statement to be incorporated in the report but the chairman deemed it wise to present it as an appendix to the report.

You will note machine No. 3 which was built recently for use in the New York harbor. The equipment described is that which we have placed on this machine. We have constant use for some of these tools and use others only on rare occasions, although when we need them we need them badly. This outfit has been in almost constant service since it was built about two years ago. About the only time it has been out of service was when it was tied up on account of ice in the river. It is the common type of floating driver that we find in every port in the United States and possibly in any port in the world.

I had my first experience with driving piles in 1877, and the pile driver that we used at that time was identical with those in use today as far as the machine itself and the scow were concerned, but the engine was entirely different. The first pile driver I ever used was equipped with what was known as a self tripper, shaped something like a pair of ice tongs. This tripper was drawn with the hammer to the head of the machine where the upper arms of the tongs went into the angle and tripped the hammer. That was far in advance of the old hand tripper, but it was a

machine used, you understand, with an old clutch engine. In those days we had no friction engines, all being of the clutch type. In the use of the old style hand trip, after the trip was released and hammer dropped, we had to pull the tripper down by hand with a man at the drum to straighten out the fall lines to keep them from becoming tangled. With the advent of the modern friction engine we have simplified the driving of piles. We can easily deliver 10 blows today to one when I first started on this class of work. The addition of air was an important step. No pile driving equipment on either land or water is complete without an air boring machine, the air for which can be supplied by the ordinary locomotive air pump and storage cylinder. Of course, tools have advanced, as have also the methods of work. I cannot say that the efficiency of the men has advanced because I do not believe that it has. However, the efficiency of the machine itself has advanced wonderfully. We have tried to recommend an up-to-date equipment and this is shown in the No. 3 outfit.

Exhibit B shows the quipment we have been using for nearly a year under contract in the harbor of New York, which is very similar to that shown for the No. 3 driver. Exhibit C shows the equipment used on driver No. 1 in the harbor at Baltimore. This machine did a large portion of our work that many of the members saw when at the convention at Baltimore in 1912. We have equipped that driver with the modern tools and the more modern equipment from time to time. I feel that in giving these lists to the association we have given something from which can be selected an outfit to meet the ordinary requirements, whether large or small. Any of these outfits shown, No. 1, No. 2 or No. 3, will compare favorably with the modern outfits of today.

T. B. Turnbull:—I am wondering what manner of device was used to put an American ditcher on a scow for driving piles in the harbor as shown in the report. We have a small railroad and if we can find some arrangement whereby we can place such a ditcher on a scow to drive piles, it will help us.

August Anderson:—The method which we used to get the ditcher on the scow was quite simple. Timbers were used to land it on the middle of the scow and the timbers were then removed. We fastened the bottom of the leads to the scow so that it would relieve the weight on the derrick. One cannot figure on having the load entirely on the ditcher because you have the weight of the hammer besides the weight of the pile, which is quite a load.

The boom would not stand this load without having a rest for the scow. It is fastened rigid after the leads are placed.

Secretary Lichty:—I would like to ask Mr. Anderson if the idea of using the American ditcher on the scow is simply to make it serve two purposes, as a ditcher at one time and as a pile driver on the scow at another?

A. Anderson:—Yes, that is the idea. In our case we have half a dozen or more jobs for the same machine, and we find we can do one as well as another. We can do dredging with this outfit and when we are through with that we put it on the road and do work along the line. On a short road, where there is not work enough for either a dredge or a pile driver continuously one of these will answer the purpose for all.

The Secretary:—We realize it is quite an advantage to use one tool for as many purposes as possible.

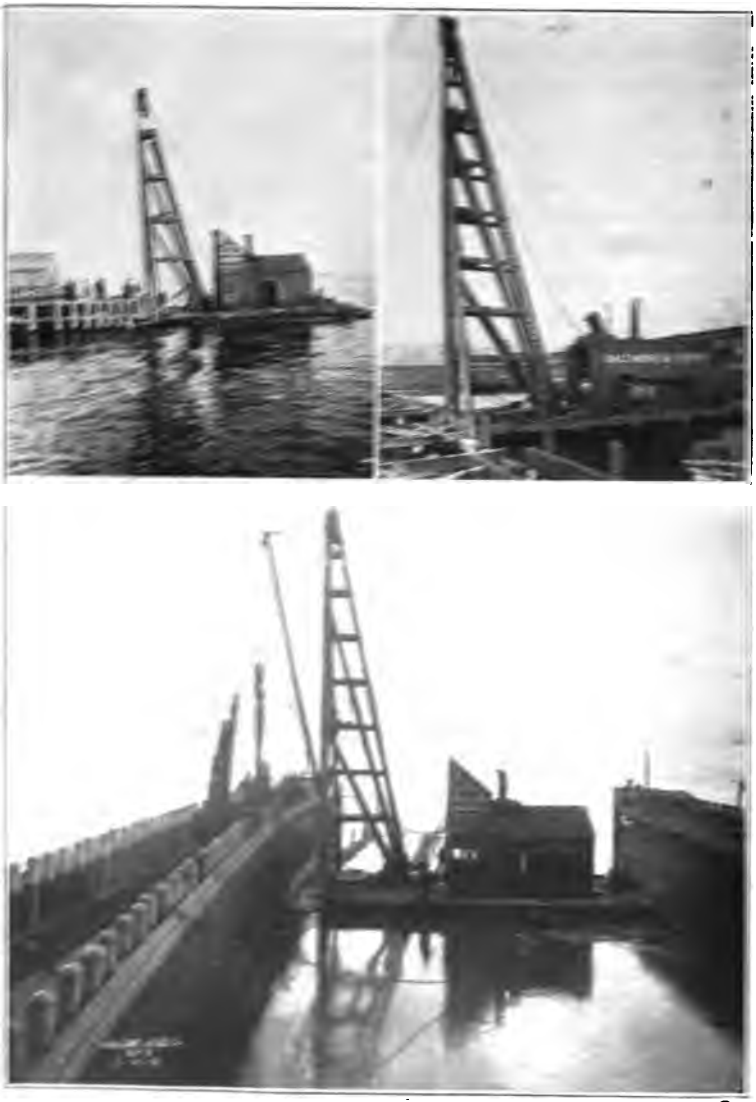
A. Anderson:—The boom shown on the pile driver is not on the driver at all times. We do not use the boom in any way in which it will conflict with the driving of piling.

Maro Johnson:—Some of the members of the committee are not committed to the recommendation for hydraulic jacks in place of mechanical or ball-bearing jacks and in correspondence with Mr. Bohland, he suggested that because of that fact it was not the intention of the committee to recommend the hydraulic jacks to the exclusion of mechanical jacks.

A. Ridgway:—The committee has mentioned one very important item without elaborating on it. I suppose the most intensive use for any kind of a pile driver is in emergencies.

When we have an emergency at night we want to get through with it in the quickest possible time. The committee simply mentions a dynamo for electric lights. It seems to me that that is one of the important equipments for a pile driver because the time when you want most to use your driver, is in an emergency when you have to work more than daylight hours. I wonder if we all have our drivers wired for electric lights. If we have not, I believe it will pay us to get our electrical engineers at work on the matter. We do not all have modern drivers, but we can all have electric lights. In an emergency a driver is much like a wrecker, and we can't work at night satisfactorily without plenty of light.

It might be well to arrange the wiring on the driver for portable lights. You may not be able to afford to buy a dynamo for your driver, but perhaps you can secure a little motor turbine head-



Floating Drivers, Baltimore & Ohio R. R.

light, or a dynamo from a locomotive. That can be fixed up to furnish a searchlight or one or two small lights and some portable lights with extension cords. I think that this is one point that the committee might have emphasized because I believe we can all do that much.

The Secretary:—I presume most of you are acquainted with the fact that there is a firm in Chicago that manufactures such a lighting outfit as Mr. Ridgway has mentioned. It is a little steam turbine that was first made for electric headlights on locomotives, and then adapted for such outfits as pile drivers and dredging outfits. It is very convenient, reliable and economical for lighting such equipment.

I. L. Simmons:—I notice in the report that the committee recommends a self-propelling pile driver in all cases. We have seven drivers on our road that are not self-propelling, and two that are. As a usual thing, we can drive more piles on a busy track, with a driver that is not self-propelling than with the others. I am not in favor of having all drivers self-propelling. There are certain restrictions which prevent you from eliminating the entire engine crew and increasing the number of piles driven. We have three drivers that are electric lighted. I hope that we will have them all wired inside of another year.

I notice also that the committee has recommended air for framing and boring. The method of handling the renewal work, of course, varies on different roads. We have one driver that drives between 4,000 and 5,000 piles in a season. We can't leave that driver at a place long enough to do all the boring and for the men to do the framing. That driver simply drives the piles and then goes to the next job. While this air outfit is all right for emergency work, where the driver stays until the job is completed, I prefer to have an independent machine that I can send along with a gang to do the other work required.

G. W. Andrews:—There are always cases that have to be taken care of by special arrangements. Most of the railroads today have pneumatic outfits of various kinds, for use on bridge work. I don't know how other roads are fixed, but I know that we are kept quite busy renewing worn or defective timbers, and a small outfit known as the pneumatic dapping machine has been of great benefit to us. The case that Mr. Simmons refers to, would, of course, require an auxiliary air machine to take care of the boring, and it would be unwise in a case like that to stop the pile driver

to furnish air for a boring machine. It would be cheaper to bore by hand. This report is to cover general conditions.

Mr. Ridgway has brought out a good point on lighting. The committee did not go into detail regarding that because there are so many roads that have conditions so entirely at variance with each other. A gentleman sitting beside me remarked to me that they have electric lights on their locomotives, and when they use a locomotive to handle a track driver, they set up a headlight on the driver from the locomotive. We can't say in the report what one should do in the case of a wash-out and expect him to follow it out implicitly, but we can say in a general way how a driver should be equipped for that work. As an illustration, we list a motor driven circular saw. I don't know anything that is so trying as to stand around at a wash-out, either on shore or on a trestle, and wait for two or three men to get down and saw the heads off of three or four piles and put the cap on before you can drive four more. It has been my experience that if the pile driver is equipped with a circular saw so that as soon as we fasten the straight edge on the pile, the circular saw cuts it off in short order. We do away with that hustle and bustle of sawing the piles off by hand.

R. H. Reid:—We have four locomotive pile drivers on the New York Central lines west, one of which is equipped for jetting piles and is furnished with a steam, as well as a drop hammer. We use portable carbide lights with those drivers for night work, which can be carried anywhere. We have four sizes, ranging from the hand size up to 30-gal. capacity. They generate the gas right at the job, and can be placed anywhere. We have had electric lights on some of the drivers although not regular equipment, but these portable lights will give better results than electric lights, because we can direct the light where we want it. The wind doesn't blow them out. A laborer can take care of them.

I don't think the matter of the driver being self-propelling interferes with its usefulness as a driver; at any rate, ours do not. We can throw the propelling mechanism out of gear in a few minutes if we want to handle it with a locomotive while if we are working on a main track, all we need with the driver is a regular qualified conductor. They will go anywhere, although they will not run as fast as a locomotive. If you have a long run to make with the driver, and there is only a short time between trains, it may be advisable to put on a locomotive, but for ordinary work the self-propeller will do. We use the large drivers for locomotive

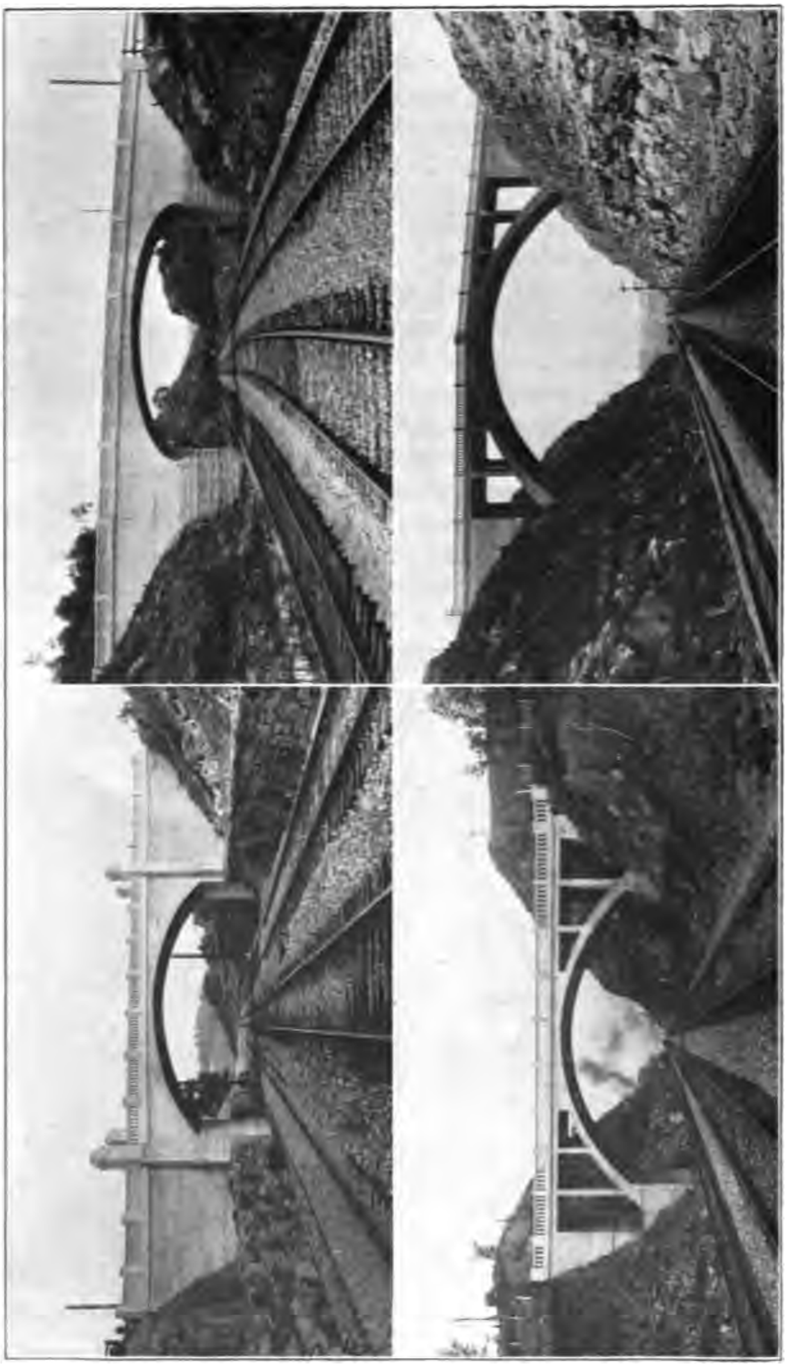
cranes as well as drivers for handling bridge work, setting concrete pipe and other material too heavy to handle by hand. We can drive piles 33 ft. out from the center of the track, and reach 28 ft. ahead. One of the others has a reach of about 20 ft. ahead and about 18 ft. on either side. The others are still smaller.

P. N. Watson:—I would like to ask if those drivers are equipped with circular saws?

R. H. Reid:—We had a driver equipped with a circular saw several years ago but later removed it. The saw had to be fitted into the leaders and removed when work was completed. We took it out and used it lately. One trouble is the difficulty of holding it at the correct height and at the correct level, so the piles will fit. I prefer sawing off piles by hand. If we put a saw and two men on a pile, it requires but two or three minutes to cut it off.

G. W. Andrews:—I know that we would all like to have Mr. Reid tell us how he has two men cut off a pile head in two or three minutes. I have not seen it done. We, unfortunately, do not have men of that kind.

Concrete Signal Tower at Alford, Pa., D. L. & W. R. R.



Group of Concrete Overhead Highway Crossings on Delaware, Lackawanna & Western Railroad.

THE DETECTION AND REPAIR OF LEAKS IN WATER MAINS

REPORT OF COMMITTEE

The detection of leaks and the repair of leaking pipe lines laid above ground do not offer any serious problem for the reason that leaks and breaks in such lines make their presence known at once and with few exceptions the break is easily accessible and the necessary repairs become merely a matter of routine work. It is quite different, however, when leaks occur in pipe lines laid underground, as such leaks are not only very hard to locate at times but are also extremely difficult and expensive to repair.

Causes of Leaks

The several causes of leaks in underground water mains may be classified in the order of their importance, as follows:

1. Jars and shocks due to vibration, etc.
2. Joints poorly made.
3. Water hammer.
4. Unequal settlement of pipe.
5. Deterioration through oxidation and electrolysis.
6. Expansion and contraction of pipe.

As the permanent repair of leaking water mains demands careful consideration and the correction of the causes, they will be discussed briefly.

Jars and Shocks Due to Vibration of Track.—Underground pipe lines subject to vibration and shocks will leak at joints and such leakage is progressive, as, if it be allowed to continue, the entire joint will be blown out on bell and spigot pipe. Pipe located along the right of way near tracks should be laid as far from the tracks as possible to escape the effect of the vibration from passing trains and to avoid track changes which might throw the tracks directly over the pipe line.

Poorly Made Joints.—Undoubtedly many of the leaks occurring in water mains result from the joints being carelessly made. This is particularly true of bell and spigot pipes, as carelessness in placing the yarn, or in pouring or caulking the joint is likely to result in trouble and expensive repairs and water losses.

Water Hammer.—Many leaks in railway water mains, and particularly in pipe lines serving water columns, are caused by the quick closing valves in these columns setting up a water hammer in the mains. When the water hammer occurs it results either in blowing out the joints or bursting the pipe; where the pressure passes from a larger to a smaller main without an outlet the pressure is doubled when it reaches the dead end. For this reason no connections of any kind should be permitted on mains serving water columns, for to do so is to invite trouble and expense from leaks.

Unequal Settlement.—Many leaks and breaks in pipe lines may be charged to the unequal settlement of the line. This is particularly true of flanged pipe although bell and spigot and screwed-end pipe are also affected, particularly where such lines pass through or under foundations of buildings.

Deterioration through Oxidation and Electrolysis.—There is no doubt that much of the deterioration of existing pipe lines has been due to a lack of consideration of soil conditions affecting the life of the pipe. Clay undoubtedly forms the best covering for underground water pipe while cinders afford the worst possible covering. If the pipe line is laid in cinders or where water will pass through cinders to the pipe line, deterioration will be rapid regardless of the quality of the material used in the pipe. The repair of leaks in a main laid under these conditions is of course only temporary and shortly requires the renewal of the main. Electrolysis has caused much damage and leakage from underground water mains, although, in general, it is not very prevalent in railway water lines. A further discussion of electrolysis appears in the report of the Committee on Water Pipe, on Page 196 of the Proceedings of 1914.

Contraction and Expansion.—Contraction and expansion occur in every pipe line. While this movement is very slight and rarely, if ever, in excess of 2 in. per 1,000 ft. of pipe, it is absolutely irresistible and must be taken into consideration in regard to its effect on leaks.

The first named cause of leaks is by far the most important in railway water service as the greatest expense for maintenance of pipe lines on a railroad arises where they are laid under or alongside tracks. This is especially true of lines laid in yards and terminals.

Cost of Repairing Leaks

In one large terminal on a Western railroad there is in service 86,350 ft. of cast iron pipe, ranging from 4 in. to 14 in. in diameter, and 27,500 ft. of smaller pipe, all laid underground. As the greater part of this pipe is laid under or adjacent to tracks, the vibration of passing trains and engines causes numberless leaks and it is necessary to maintain a regular gang repairing underground leaks at this terminal. This gang usually consists of a repairman and three laborers, but as some of the lines are 10 or 12 ft. below ground, additional help is often required.

A leak in a 10-in. cast iron main laid at a depth of 10 ft. and located only a short distance from the shore of a lake recently required five ditch pumps to keep the water down while the pipe was being uncovered and repairs were being made. As the leak was under tracks in a busy freight yard it was necessary to support the tracks and shore the trench heavily. The cost of repair-

Leak in a Water Main

ing this one leak was $150. This is, of course, an exceptional case, but if a careful record was kept of the cost of repairing all leaks the amount spent would be astonishing.

Records have been kept of the cost of repairs to cast iron water mains in a large Southern terminal. The principal repairs were to 4-, 6- and 8-in. pipe laid at an average depth of 3 ft. 6 in. The pressure on the mains is about 90 lb. normal with 140-lb. fire pressure. It was found that 85 per cent of the leaks occurred under tracks. The average cost of repairs was $10 per leak, and this figure may be taken as a fair average cost on all railroads.

Within certain limits there is little difference in the cost of repairing various sizes of cast iron underground mains as the

principal expense is incurred in the excavation, unwatering, shoring and protection of the trench, the actual expense of repairing the leak being comparatively small. The following table showing the amount and cost of air, steam and water waste through orifices of various sizes will give some idea of the expense of leaks other than the cost of repairs:

	AIR		STEAM		WATER	
Size of Opening	Number of cu. ft. wasted per mo. at 100 lb. pressure	Total cost of waste per mo. at 15 ct. per M cu. ft.	Number of pounds wasted per mo. at 100 lb. pressure	Total cost of waste per month at 50 ct. per M lb.	Number of gal. wasted per mo. at 40 lb. pressure	Total cost of waste per mo. at 15 ct. per M gal.
½ in. ...	17,798,400	$2,669.76	805,000	$402.50	1,231,000	$184.65
⅜ in. ...	9,979,200	1,469.88	460,000	230.00	692,400	103.86
¼ in. ...	4,449,600	667.44	203,000	101.50	307.700	46.15
⅛ in. ...	1,114,560	167.19	50,500	25.25	76,900	11.53
1/16 in. ...	278,640	41.79	12,750	6.37	19,200	2.98
1/32 in. ...	69,552	10.44	3,175	1.58	4,800	0.72

Detection of Leaks

The detection of leaks in water mains laid underground is sometimes a very serious problem as such leaks do not always show on the surface, particularly where the mains are laid in a porous formation such as sand, cinders, loose rock, etc., or in proximity to sewers and drains. Leaks in mains laid under these conditions may assume enormous proportions and continue for years before they are discovered. It is needless to say that the losses through such leaks will justify considerable effort and expense to overcome them.

As an example of the losses that may occur in underground water mains from leaks that do not appear on the surface, a survey made at Washington, D. C., showed 93 concealed leaks on underground water mains which were wasting 1,034,000 gal. of water per day. The presence of such leaks is often made apparent only through a greatly increased consumption of water. Even then they are sometimes difficult to locate. It is obvious that so far as determining the presence of leaks is concerned, the difficulty lies with those that do not show on the surface. With a straight line of pipe or a system of piping where the location of each line as well as the outlets are definitely known the procedure is comparatively simple as it consists merely of closing the various outlets, maintaining a pressure on the line and checking the losses through the decrease in pressure or by the speed of the pump. If the line is metered the meter reading will, of course, show the exact loss and if it is possible to isolate each line the survey may be confined to any particular part of the system.

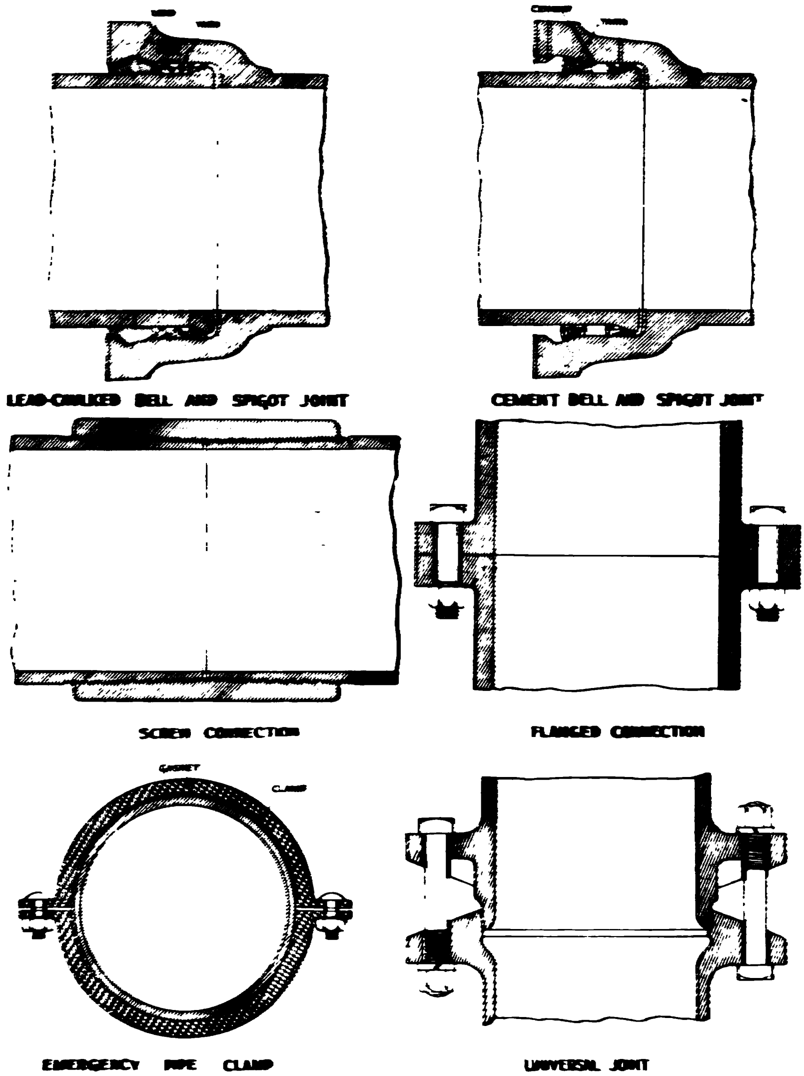
On extensive and complicated systems of pipe lines such as at shops, yards and terminals the location of lines and outlets is not always known and the valves controlling the various connections may leak, with the result that it is almost impossible to make a pressure test of the pipe lines. A check of the quantity of water pumped against the actual requirements will often indicate a leakage but as a general rule only a leak of considerable proportion may be found through this method. An examination of the sewers and drains will sometimes show whether any abnormal waste exists. Other methods may suggest themselves in each case.

After it has been determined definitely that a leak exists, the matter of locating it is a still more difficult problem and no rule may be suggested that will prove infallible. The methods generally followed are the use of an aquaphone, or what is generally known as a "leak finder." This instrument is similar to a common telephone transmitter connected to a small rod instead of a wire. The rod is applied to the pipe and under favorable conditions the sound of the leak will be transmitted to the ear; by following the pipe the location of the leak may often be determined. The use of the aquaphone on underground pipe lines may, however, entail almost as much excavation as would be necessary to uncover the line. The use of this instrument also requires considerable practice and experience to locate leaks quickly. Another method is to make a comparison of the pressure on the line at various points as a pressure drop will occur on the pipe line beyond the leak in the direction of flow due to the decreased friction.

An instrument known as the pitometer has been used extensively in the larger cities to determine the presence of leaks. The pitometer is a device by means of which the velocity of flow in the main may be determined. While there are, of course, points where the pitometer could be used to advantage in railway water service, its use as a general thing is limited.

Repairing Leaks

No set rules may be laid down for the repair of leaks as the method of repair will depend upon the nature of the break and the materials available for repairs. This is particularly true of emergency cases. The method to be followed in making repairs will depend upon the nature of the leak. The various types of



Typical Joints for Water Pipe.

joints commonly used in railway service are shown in an accompanying cut. The majority of leaks will, of course, result from bad joints in bell and spigot pipe on account of the preponderance of this type of joints.

The following list comprises the tools required for repairing bell and spigot joints in cast iron pipe:

1 track chisel.
2 cold chisels, ¾-in. by 7 in.
2 diamond points, ¾-in. by 6 in.
1 2-lb. machinist hammer.
1 2½-lb. caulking hammer.
1 lead pot.
1 set pipe jointers for each size of pipe.
1 3-in. trench pump with 15 ft. of hose.
1 No. 1 yarning tool.
1 No. 2 yarning tool.
1 No. 1 caulking tool.
1 No. 2 caulking tool.
1 No. 3 caulking tool.
1 No. 4 caulking tool.

Additional tools, such as picks, shovels, wrenches, etc., are usually available so that it is hardly necessary to include them in the above list. It is advisable to keep in stock a few pipe clamps similar to the one shown in the cut, for quick repairs as a split or hole in the pipe can be repaired in a few minutes with a clamp of this kind. Lead, rubber or leather may be used as a gasket. A clamp of this kind makes a permanent job and will last as long as the pipe. If an iron clamp is not available temporary repairs may be made by using a wooden clamp. Pits or holes in pipe may often be repaired by tapping out and plugging the hole.

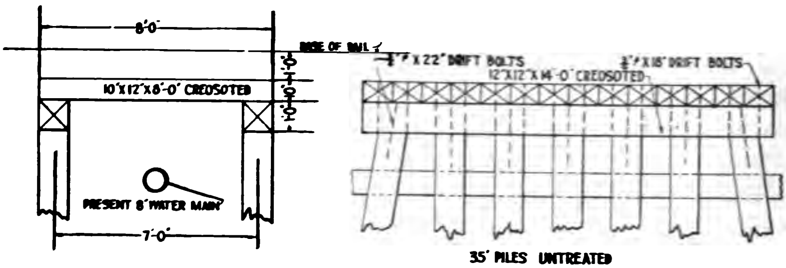
The majority of underground leaks will occur in lead joints. The advantage of a joint of this kind is that it can usually be repaired by recaulking. Lead wool can frequently be used to an advantage for making repairs, especially in wet trenches or on submerged mains where it would be difficult to use hot lead.

When repairs are made to leaking pipe lines every effort should be exercised to make permanent repairs. There are too many cases where the same leak is repaired time after time, causing a continual expense, where a study of the cause of leakage would often permit of applying corrective measures that would eliminate the expense of repairing such leaks for all time.

The most persistent leaks are those occurring in pipe lines laid under tracks and caused by the vibration and shock of passing trains. This trouble may be corrected by supporting the track so that the weight does not come on the pipe. The method to be followed will depend upon local conditions and may consist of placing the service pipe within a larger pipe, or a concrete box.

In extremely soft, marshy ground it may be necessary to provide a trestle similar to a standard ballast deck trestle as shown in the accompanying cut. There may be those who will question the advisability of incurring the expense of such protection for pipe lines for we are inclined to overlook the importance of these water mains because of the fact that they are underground, but if they were brought to the surface the realization of their condition and the cost of the wasted water would justify considerable expense for proper maintenance and protection.

C. R. Knowles, Chairman,
J. H. Grover,
J. Mellgren,
Committee.



I. C. R. R. New Orleans Terminal Timber Bridge for Protection of 8 in. Water Main

DISCUSSION

James Dupree:—While the subject of Detection and Repairs of Leaks is up let us first mention some of the causes of leaks. If cast iron pipe is properly laid in the first place there will not be the necessity for so many repairs. We need not enter into a long discussion how to make joints so they will hold, but it certainly pays to do the work properly when the pipe is laid. It is too often the case when we have a long line of pipe to put in to hurry the job for " we have something else to do on the other side of the hill." This should not be permitted but ample time allowed to do the work right, because leaks are serious and expensive and they should be avoided if at all possible.

The report includes a small illustration showing a bad leak at the top of a joint. Ninety-five per cent of the leaks occur at this point. The reason for this is that some of the men who make these joints are incompetent. I notice that two cold chisels and one track chisel are included in the tools listed in the report. The cold chisel

should not be there, because the proper way to caulk a joint is to start at the bottom, caulking around to the gate, using a 3-lb. hammer to drive the lead in and cutting it off with the caulking tool. When the lead is poured there are two streams, one running down each side and sometimes air pockets are formed, causing a blow-out. Quivers of air can be seen coming out through the hot lead, and this is where leaks always occur if not properly caulked.

The detection of leaks is not always so easy, especially where there is porous soil or loose rock covering, and while there are various methods to detect leaks they are usually not within reach of the average railroad man and he is compelled to get along with the old methods as best he can.

I have repaired leaks in many ways and one frequently has the opportunity to exercise his ingenuity in applying remedies. Jackets can often be applied, or pieces of old boiler iron clamped on over gaskets which may save taking out a joint of pipe. While these are usually considered temporary repairs they are often continued indefinitely.

E. A. Demars:—I have had considerable experience with both, flange, and bell and spigot cast iron pipe. I don't think leaks always come from blown joints on top. The heavy pressure and vibrations from engines operating over pipe lines will cause lead joints to spring and get thin on top until the pressure of the water forces it out. In making repairs, I never use the cold chisel, but I always use the caulking tool to cut off the gate. At times the top of the gate will spring on account of the friction and vibration of the lead.

C. R. Knowles:—I think Mr. Demars has made a good case for the poorly-made joint. I have seen many gates where a man would have considerable difficulty in disposing of the lead by driving it into the joint. There are certain limits to the compressibility of lead. If you have a blow-hole, and do not have the gate high enough to fill the joint, it is necessary to drive the gate, but I don't consider a joint made in such a manner that it is necessary to drive the gate within the bell a properly made joint. It is true, as Mr. Demars states, that pipe lines laid under tracks must have particular attention on account of the action of the ground over the joint, which will be inclined to make the lead thin on top. The tighter the lead on the top of the joint is the better it is of course for the joint. Hammering the lead in, as you know, has about the same effect as the

crystallization of metal. The lead will harden by driving and of course it will better resist the vibration.

I want to read into the report a few extracts from the Journal of the American Water Works Association, of July, 1920. The article in question deals with methods not given in this report.

"First, the simplest method for the location of leaks is by observation, if it can be called a method. It would scarcely seem to take much experience to say that there is a leak if water is seen bubbling up in a city street, but its exact location may not be immediately below the point at which the water is appearing. Leaks discovered by observation in this fashion may follow along the pipes for some distance before making an appearance. If the leak is not located in the excavation made at the place of appearance a pointed steel rod about ½ in. to ⅜ in. in diameter and 5 to 6 ft. long can be driven down to the pipe through most soils. If, on withdrawal, the rod is found to be moist, the indications are that the leak is further upgrade, while if the rod is dry, the leak has been passed, and lies between the last two points of driving the rod."

Another method that is interesting but perhaps not of any great value in railroad work, is what is known as Darney's leak detector. It is a sound-taking instrument that does not require making direct contact with the pipe. The sound detector is set on a brace or table which rests on the surface of the ground, and is protected from air currents by placing the box containing electric cells over it when in use. The vibrator is set on the detector and electric cells and transmission is made from the amplifier to sensitive telephone receivers. The instrument is so sensitive that it will detect the sound through the ground at the ordinary depth at which water pipes are buried. The instrument cannot be used in a high wind or where other noises may interfere. Very satisfactory results have been obtained by its use in cities.

An ingenious method based on volumetric analysis was used for the location of a leak in a pipe line during the construction of the Field Museum in Chicago. (This pipe line was laid under the Illinois Central tracks.) A piston was made which fitted the inside of the pipe, a Y-branch was inserted in the pipe line, the piston was put in the pipe through this line, and the cable attached to the piston passed through a patched joint. A sufficient amount of water was then turned in the pipe to keep the piston moving. When it reached the leak the length of cable measured the distance to the leak. It

should be understood that this leak was under a fill, 30 or 40 ft. high in places.

A simple method for the location of a leak in a submerged pipe is to dump a quantity of bluing in the line. The bluing will appear in the water, and thus show where the leak is. There are other methods that may be as effective and probably more scientific than the one just described.

E. L. Sinclair:—The paper is confined entirely to the detection of leaks after a pipe is in service. I have had a little experience in detecting leaks at the time the pipe is laid. We laid about 5⅓ miles of 12-in. pipe a few years ago, and in order to locate the leaky joints as the line was being constructed, we put a cap on the end of the pipe when we had a section laid, and filled it with air from a compressor mounted on an ordinary farm truck so that we could pull it around wherever we wished to use it. We used a pressure of 100 lb. for these tests. Our method was to swab the joints with soapy water. We could see the soap bubbles wherever there were leaks, and re-caulk them until we could maintain the section under test for 24 hours with a very small loss of air pressure. This line has now been in operation three years and there have been no leaks that came to the surface through ordinary porous soil until this year, when I think one leak developed.

Maro Johnson:—I would like to inquire how long the sections were that were filled with air for testing the joints.

E. L. Sinclair:—The lengths of the sections varied. We put in a gate valve and blow-off for blowing the mud out of the low spots in the pipe, and the sections conformed largely to the location of these valves, some of the largest being about 3,000 ft.

E. A. Demars:—We have a water line possibly 3,500 ft. long, running from a pumping station to a water tank. This line follows the river, in marshy ground, for a distance of about 2,500 ft. Due to the pulsation of the pump creating a vibration in the line in the marshy ground it has been impossible to hold the lead in the joints. On that line we found it didn't matter how well we put in the lead, how well we caulked it, or how carefully we placed the timbers under the line, it didn't keep it from vibrating, so I devised a method of using clamps, placing one clamp on the rear of the bell and one on the front, the two being tied together with two eye-bolt screw connections. After putting in the lead and caulking it well, I put

the clamps on and brought the joint up tight with bolts which corrected the trouble.

A. Fraser:—I want to ask how you take care of leaks resulting from water hammer. We have several leaks under tracks, where the joints were so bad that we had to keep after them continually.

C. R. Knowles:—You will find a complete discussion of water hammer in the 1914 proceedings. That is something that can be remedied only by the proper use of relief valves and air chambers.

E. L. Sinclair:—On the question of water hammer we found on the line that I referred to, that when the pump was shut down, there was a very heavy surge. To overcome this, we installed an air chamber in the pump house, which very materially reduced the pressure on the pipe. The normal static pressure was about 78 lb. and when the pump was shut down, it would run up to 125 to 140 lb. After it blew out a wash-out plug we installed the air chamber and have had no further trouble.

C. R. Knowles:—I think Mr. Fraser has reference to one form of water hammer and Mr. Sinclair to another. Mr. Fraser's is due to valve closure and Mr. Sinclair's reference is to surges due to to pumps which can be remedied by the use of an air chamber through the outlet of the pumps.

F. E. Weise:—All of the discussion so far has been in regard to leaks in lead joints. Cement joints have been advocated more or less of late. Has any one here had experience with cement joints? Have you heard of them? Have they caused any trouble, and how do you handle them?

C. R. Knowles:—I don't think cement joints have been used very extensively. I also refer Mr. Weise to the 1914 proceedings in which cement joints were discussed. The principal objection to them is their rigidity. A cement joint will allow no deflection whatever of the joint.

J. Dupree:—I have tried cement joints on a suction line of 6-in. pipe. I put yarn in first, driving it in tight, and used about 3 in. of cement, placed with a stick. I let it stay set for 30 hours.

C. R. Knowles:—The accepted method of making a cement joint is a little different from Mr. Dupree's method. The usual cement joint is made by first joining a pipe with a thickness of about ½ in. of yarn; then applying ½ or ¾ in. of neat cement, forcing that layer of cement in place with another layer of yarn, and finally closing the joint with neat cement.

RECRUITING BRIDGE AND BUILDING EMPLOYES

REPORT OF COMMITTEE

There has been a marked change in the labor situation since the subject of "Recruiting Bridge and Building Employes" was recommended as a suitable topic to be presented to this association and it is likely that if present conditions had prevailed a year ago, it might not have been suggested. One of the members of this committee makes the statement that at the present time it is not so much a question of recruiting men as of persuading our superior officers to allow us to keep the men we have. It is to be hoped, however, that the present situation will not prevail long and that we may soon have need to consider methods for recruiting men. The present situation has one point in its favor in that crews now, while small, should be composed of picked men, men who are most efficient in their various occupations and for this reason will form the nucleus of a much more perfect organization when it is necessary to hire additional men than was possible during the strenuous days of the war. We may apply to good advantage, the old adage, "In time of peace, prepare for war," by studying our probable future needs and thus have some definite idea in mind when called upon to increase our forces. The time will surely come when we will need to do this, although we cannot determine when. It is hoped therefore that a study of this subject will be considered important enough to bring out a profitable discussion.

In the past, railroad work at a smaller rate of pay was attractive to many men because it proved to be steady work, rather than to take work at a higher rate that was irregular and indefinite with more or less idle time. The war brought about a different condition; men were able to get good wages, fairly steady work and more comfortable living conditions if obliged to be away from home. It will be difficult for men to overcome the desire for a continuance of these conditions and this fact must be taken into consideration when increasing activities again bring up the problem of recruiting men, because they are among the things offered in return for service.

When men are invited to enter the service of the railroad

they should be made to feel that it is the intention to treat them fairly, that their grievances, if they have any, will be given careful consideration and that if it is found that their complaints are justified, remedial action will be taken promptly. The foreman should show a disposition to be fair and impartial, be ready to grant minor privileges consistent with the rules of the railroad company and should not take unfair advantage of technicalities or be guilty of what may be termed "sharp practice." Men in supervisory positions should at all times make the men under them feel that they have an interest in their personal welfare, be kind and considerate, yet fair and firm in their demands, protect the interests of the loyal men and at the same time act with equal fairness and firmness in disciplining the disloyal. The men must be made to realize that they also have obligations and that they are expected to respond to their superior officers in the same spirit of interest and fairness.

In order to study this subject and profit by its discussion let us assume that we are facing a condition that calls for an increase in our bridge and building forces. Even with reasonable and desirable working conditions to offer, it will be quite a problem to find desirable men. The locality may have in it industries such as lumber camps, sawmills, factories, mines, etc., that are active enough to give steady employment to at least the better workman. Seasonal work at higher wage rates may draw men away, such as harvest time. The problem then is to keep your present force from slipping away and many times this can only be done by good treatment and calling attention to the fact that the other work, while it may look alluring at the time, will only last for a short period and will be over about the time that the railroads' needs will also be less. Experience indicates that the most satisfactory workmen are those who live on the division or section on which they are working and of these the most desirable are those who are married and who visit their families weekly. A married man with a family is less likely to be attracted by the seasonal and occasional occupations at higher wages, because he plans for the future and he knows by experience that he cannot afford many periods of idleness.

Replies to inquiries indicate that the shipment of men from large cities by labor agencies is seldom satisfactory for bridge and building service. The men so obtained are "floaters," and do not remain long enough to receive proper training or to be-

come trustworthy and efficient. Fortunately it is not often necessary to hire men in very large numbers for bridge and building work and the supervisor and foreman may do many things that will keep them in touch with available men.

In going over his district a supervisor can make inquiry at the various cities and towns regarding probable recruits. He can ask station agents to be on the lookout for desirable men and urge his foremen to make inquiry at the towns where they live. In this way he will at all times have a list of available and desirable men. It will also be found that section gangs frequently contain bright young men who will develop into good bridge and building men. Their experience and training in section gangs makes them familiar with railroad conditions, a training very desirable for bridge gangs. When necessary to open a bridge, it cannot be anything but a great satisfaction to a foreman to have several young men whom he can confidently send out to flag trains and therefore feel easy that he will not have to worry on that score and it also leaves the more experienced bridge men where they can do the most good. Some supervisors have had very good success by following this method.

Having let it become known that you are in need of additional men and that applications are desired, make it a point to properly acknowledge each application, letting the man know that it is receiving consideration, and also make a proper record. You may receive more applications than can be used on this particular occasion but a week or two later you may be in the market again. Every applicant should be investigated carefully, not only as to his qualifications as a workman but as to his habits and temperament. Is he cleanly and companionable? Can he bunk with other men without causing disturbance or friction? One grumbler in a camp can do a lot of harm. Is he honest and trustworthy? Men in camp have clothes and valuables that they must leave in camp while at work and they must feel that they are reasonably safe, especially as far as their fellow workmen are concerned.

Some supervisors make a practice of getting acquainted with applicants, even though they do not need their services at the time, by writing to them or looking them up when in their town This has been done with good results. They know just where to go when the need for more men comes.

Occasion may arise when it is necessary to call upon a labor

agency in a large city to supply men for bridge and building work. Unusual conditions call for special treatment, but such a case is no doubt for a special job and involves temporary employment only. This condition must be faced by placing orders with the most reliable labor agency available and it would be better to send a man from your own forces to interview and select the men. The selection of men in this way is of course at best a matter of personal judgment and it will be necessary after a few days' service to weed out the less desirable men.

When men enter a railway company's service there should be a definite understanding of what is required of them and what they will receive in return. The questions of wages and occupation are settled in advance, but just as important as these are the new man's relation to his fellow workmen, his assignment of duties, his place at the table and in the bunk car. There should be definite rules of behavior, time for retiring and rising, for smoking and talking in the bunk cars, a definite time after which everything must be quiet, sanitary arrangements and numerous other things that are necessary for the conduct of the crew. Sometimes such rules are printed and posted in the cars or camp, but this is not always necessary. The important thing is that the men understand what the rules are and that they will be enforced. It will be found much easier to maintain discipline if the newcomer understands these matters in advance.

One of the tests of a good supervisor and a good foreman comes when men are scarce and outside interests try to pull the men away. Fortunate is he who at such a time can hold his most reliable and efficient workmen and retain their interest and good will. It is excellent advice to establish among the men working under you, a reputation for fair dealing; it will go a long way in aiding you to find suitable and desirable men.

F. W. Hillman, Chairman,
S. C. Tanner,
J. E. Buckley,
J. K. Davidson,
Frank Lee,
E. G. Storck,
Committee.

APPENDIX

The following is an abstract from the book of rules issued by the Baltimore and Ohio railroad, entitled "Instructions concerning the Maintenance of Way Department," and which has a bearing on the discussion of the subject, "Recruiting B. & B. Employes."

General

The head of each sub-department must supply copies of these instructions to his subordinates, see that they are understood and enforce obedience.

To enter or remain in the service of the Company is an assurance of willingness to obey its rules.

Obedience to the rules is essential to the safety of passengers and employes, and the protection of property.

The service requires the faithful, intelligent and courteous discharge of duty.

To obtain promotion, capacity must be shown for greater responsibility.

Employes in accepting employment assume its risks.

The safety of patrons and trains is of the first importance and employes in the maintenance of way department must do all in their power to prevent accidents, even though in so doing they may have to perform another's duty.

In all cases of doubt or uncertainty, the safe course must be taken and no risks run.

The use of intoxicants while on duty is prohibited; their use at any time, or the frequenting of places where they are sold, is sufficient cause for dismissal.

No employe is allowed to contract any bill or other obligation on account of the company, or to use the company's credit, unless authorized by the proper officer.

Frequent attachments served against an employe's wages or his assignments thereof will be sufficient cause for his removal from the service.

Minors must not be employed except as permitted by law, and then only after written consent and release from their parents, or guardians, has been obtained on proper form.

In case of danger to company's property, employes must unite to protect it.

All persons whose duties are in any way affected by the time-table must have a current copy with them while on duty, and must observe all time-table rules and special instructions governing the movement of trains.

The articles furnished by the company for the use of the employes, must, on their leaving the service, be returned to the proper officer.

Maintenance and Regulation of Camps

The foreman is responsible for the proper maintenance and policing of all camp cars, bunk houses, etc., occupied by men under his charge. The master carpenter, supervisor and signal supervisor must frequently inspect the camps occupied by their men and see that these regulations are enforced.

Camp cars set off trucks for permanent use and bunk houses must be placed in inconspicuous locations, away from the main track, stations and dwellings, wherever possible. They must be kept in good repair and neatly painted at all times.

Where camp cars are to be located at a point for one week or

longer, when practicable, they must be placed on a temporary track. If this cannot be done, they must, where such track is available, be placed on a back track away from the main track. When placed on an operated track, ties must be set in, or rail taken out, to prevent cars being run in against the camp cars.

When camp cars are set in on a track next to the main track, or a running track, the cars must be closed on the side next to the track. No ladders or walkways must be permitted on the side of the cars next to such tracks.

All camps, whether of cars or bunk houses, must be supplied with privies, placed over holes of sufficient depth to insure complete covering when abandoned. Frequent application of quicklime must be made to insure complete disinfection.

All garbage must be collected in metal cases provided for that purpose, and must be disposed of each day by burning or burying.

All waste water from sinks and wash basins must be collected in barrels and emptied into some watercourse, at a sufficient distance from the camp to prevent it from becoming a nuisance.

All boxes, papers and other debris must be cleaned up daily and burned.

All cars and bunk houses must be kept clean and well ventilated at all times. They must be periodically fumigated.

Special attention must be given to the water supply for drinking and cooking purposes. PURE WATER MUST BE FURNISHED. Where necessary, wells must be driven, a suitable pump provided, and the top of the well so constructed as to prevent contamination.

All local sanitary and health laws and ordinances must be complied with.

When extra gangs are furloughed, the stoves must be removed from the camp cars and stored at the local storehouse.

DISCUSSION

J. P. Wood:—This report brings to mind some of our own experiences. I think the majority of supervisors have had their trials and tribulations during the past few years, especially since 1917. I know I have, but I have believed for years in a great deal of what is expressed in this report. I have tried to follow these principles. During these last few strenuous years I have had a fair quota of men at all times and have been able, by applying some of the principles that are mentioned here, to hold the men who were with me before these strenuous times came on. Some of my foremen will bear me out in the statement that we have numerous men who have been with us from 5 to 8 years, and some who have been with us from 10 to 14 years.

There is a world of thought in this report. If you will study the principles of fair play between man and man, which it enunciates, and fair play between the men and the company that you represent, I know from actual experience that you will benefit by it.

This suggests to my mind another matter; that is the bene-

ficial results of attending these conventions. It broadens the minds of the supervisors so that when they go home they will not be so hide-bound and will give the men under them a little more of a show. I want to say (and I believe that Mr. Andrews, one of the oldest men in this convention, will bear me out in this respect) that the attendance at these conventions year after year broadens our vision, enables us to treat our men more fairly and squarely, and enables us to apply the Golden Rule. I have said many times to some of our own members on the Pere Marquette, "If you fellows would get out more, you would not have so much trouble in getting men when you want them."

E. T. Howson:—It has always interested me, both in direct railway service and in watching the men employed by various railroads, to see how carefully they prepare specifications for the material they used, and then to observe how carefully they checked them to see that they conform to those specifications. After those materials are delivered, the men who use them are provided with instructions regarding their use. Yet there has been no time in recent years when more than 50 cents of the dollar has not been spent for labor rather than materials. That proportion has risen as high as 65 cents in the last five years. At the present time, approximately 60 cents out of every maintenance dollar still goes for labor. In spite of this fact we have no rules of any consequence for the selection of labor, but only the most general rules for the guidance of the men handling it. If we are short of men, we pick up those who may be available when the time comes. We don't train our foremen, or our supervisors in the art of handling them. We should do that. The big investment is in our men. We tell the foreman how to handle the timber, and the steel, but let him worry along with the men as best he can. It seems to me that it is no wonder that we get mediocre results; not all of it is due to the men. Part of it is due to the fact that we have not trained the men who are using the labor as we check the use of the material.

This is a subject on which we can theorize at great length and yet I feel more strongly every year that we have not given the subject the attention it deserves. The biggest saving that we can make today is in studying the men in the gangs; first getting the right man in the gang by paying more attention to his selection, then following him through the training period and after he becomes a trained workman, holding him in the gang.

I think there is much to the point that Mr. Wood emphasized —holding him. Every man in the gang represents an investment. The employer has a large investment in that gang, and nothing is more destructive to that investment than a large turnover.

T. B. Turnbull (Ann Arbor):—It seems to me that the supervisors should pay more attention to instructing their foremen as to how they shall treat their men. During the last three or four years the foreman, as well as the supervisor, has become discouraged with the men. It seems to me that supervisors should instruct their foremen to show the men that, although they did not do quite the right thing during the past few years, the railroads are willing to do what is right, and I think the managements are. The men deal entirely with the foremen in requests for minor things, as for example, transportation requests. The foreman handles these entirely, and many times he will say," No, I do not think we can do so and so," without taking it up with someone higher up. I think a foreman should be taught that if a man wants something, and he does not know whether he can grant it or not, he should take it up further. I believe the railroads all over the country want to be fair with the men and the men should be given to understand this. If the men want favors, let them know that they may have what is in reason, and then the feeling will go out that they are not such bad people to work for. That is the case with the road I work for, and I believe it is so with the majority of the railroads. Let's educate our foremen to be considerate and just to the men who are working under them.

F. E. Weise:—Does any one have a definite plan for keeping in touch with men? Do you keep a list of good, reliable men that you may wish to employ in the future? Have you any method of keeping in touch with station agents, acquaintances or friends who will keep you advised of available men? Suppose a man gets sick and you need someone to replace him for a few weeks or months; or a man dies and you need a man with some special training, how do you locate him? This report could well be supplemented in that way.

J. P. Wood:—It has been my practice when receiving applications to file them under the head of "men wanting employment" and then keep tab on them. It has also been my practice when I receive those applications by mail to see that they are answered so that the men know I have received their letters. The applications are all kept on file, and a record is kept of them in a separate

book, so that it can be referred to readily. Men also come into the office frequently and make application for employment in person. Their names and addresses are likewise taken and recorded. If I meet some fellow outside who looks good to me for the future, I keep a record of him in the office. We keep those applications where we can refer to them constantly.

R. C. Henderson:—I find it a good plan when receiving applications for employment to turn them over to the foreman and if it is necessary that they be answered, he does that. If he has an opportunity to become acquainted with these men he does so. I think the foremen should take care of that.

L. Beck (Virginian):—I always leave it to my foremen to hire their own men and if they do not know of anybody, they come to me for help. If I get applications, I refer them to whatever foreman needs men. I feel that if I send a man to a gang the foreman feels under obligation to keep him, whether he is any good or not. Therefore, it seems best to let the foreman hire his own men.

Secretary Lichty:—I am afraid that it is not always good policy to leave that entirely with the foremen. I believe nearly all of you here will bear out the statement that some of your foremen are very poor in selecting material for their crews while others are very good. It is a good plan where you have a foreman who keeps up a good crew. At the same time, I think it is a good plan for the supervisors to instruct their foremen along these lines and not leave it entirely to them, especially if they exercise poor judgment.

R. C. Henderson:—I did not wish to infer that I leave this matter entirely to the foreman, but I try to make him realize that it is up to him. We investigate the men before we hire them, but we wish the foreman to pick the men.

R. H. Reid:—One good way of getting the most efficient men is to let the foremen realize that they are held responsible for results in their gang, no matter who hires their men. If men come into the office looking for employment and are hired and sent out, they are given to understand that if there is any question, the foreman has the right to discharge them. The fact that they are sent from the office does not mean that the foreman has to keep them. Every foreman is given to understand that the performance of the gang is up to him and that he will be held responsible for his men, and beyond that, that his own chances for promotion depend upon the performance of his gang. He is given to under-

stand that he has to make a showing with his gang in order to warrant his promotion to supervisor or other higher position.

Some of our members were speaking of long-time service. I did not hear anyone mention over 15 or 18 years. On the New York Central, we have men who have been with us 40 years and more. One man under my jurisdiction has been with us 46 years and has no intention of leaving until pensioned. There are several, in fact, with similar service records. They have been tempted by contractors and other railroads, but are still with us.

F. E. Weise:—Have any of you any definite set of rules to be given to new men or how are they given instructions? Are they given instructions verbally by the foremen, or have you printed rules?

R. H. Reid:—We have quite a few general instructions that we call circular letters or bulletins that are posted in the camp cars. All of the men, when taken on, are given careful verbal instructions by the foreman, and by the assistant supervisor. We have four assistant supervisors on the Lines West, and each one of them is in very close touch with the work on his division. They know all the men on their divisions personally. In fact, I myself know nearly all of the men out on the line and they are especially instructed in the ordinary dangers of bridge work. Matters of permanent importance that can be covered in bulletins are posted in the camp cars.

G. W. Andrews (B. & O.):—In the discussion, we seem to have lost sight of the fact that the large percentage of the railroads in this country have issued books of instructions from time to time. On the Baltimore and Ohio we have a book of instructions for maintenance employes that outlines the general character of the work to be done and the manner in which it is to be handled by the supervising officers, from the chief engineer of maintenance down to the foreman in charge of the track gang. It covers the work of track, bridge and building, water station, and signal men; in fact, all of the employes of the department. The rules outline the proper performance of the duties of all concerned, and the foreman is supposed to read that portion of the rules governing his work to his employes from time to time. We have instructions governing our methods of bridge inspection and the keeping of records. In the past, there were times when we could train our men and keep them but in the times that we have passed through in the last few years and are still in the midst of, we

have all been compelled to let some of the very best men go, and I question very much if we ever will get them back. They cannot afford to wait for us to take them back. They will get other jobs. Many of them will probably get jobs paying them better than we were paying them.

F. E. Weise:—Has any one had experience in recruiting bridge and building men from section crews?

R. H. Reid:—Some of our best bridge men on the New York Central were taken from the sections. Of course, we have to be careful in taking them. We can not go direct to the section foremen and take their men away from them, because the roadmaster also has difficulty in picking up men. We cannot deplete his forces for the benefit of our own, but if our foremen find men on the section who appear to be bright, active young men who would make good bridge men, they take it up with the roadmaster, and if it is satisfactory with him, we have in some cases taken them over into the bridge department and some of them have made excellent men. Some of the best men we have come up in that way.

J. S. Robinson (C. & N. W.):—We have done the same thing. Nearly all of our section men now are either Italians, Greeks or Bohemians. We have taken Bohemians or Italians out of the section gangs and put them on water service, and found them very good mechanics in the majority of cases. I think this is a good idea where the track department comes under the maintenance department. If a man has worked on a section for many years without any advancement, but has the idea that if he works hard he may get into another department, it gives him ambition. I do not think that nationality ought to make any difference for you will find good men of any nationality.

R. H. Reid:—In connection with the question of nationality raised by Mr. Robinson, we do not employ any man in the bridge department who cannot read, write, talk and understand English. The question whether he is foreign or native is not essential.

Theo. Morin:—We have a case on the Boston & Albany where a man who was a section laborer in 1912 became a foreman of a bridge and building crew within five years.

A. Ridgway:—I came here to get some information. I have gotten it from this report. To my mind it is something of a classic. That which is said therein is not a mere collection of words. There are volumes written between the lines. There is one point on which I would like to ask the practice, preference and opinion of those

TREATED TIMBER

By C. M. Taylor

Mr. President, and Gentlemen:—I am not a bridge and building man in the sense of the word that I build bridges and buildings, but my work lies in trying to make those bridges and buildings that you men build last longer than many of them do today. In other words, my problem, as a timber preserver, is to take the wood that you would ordinarily use and make it last longer by preservative treatment.

Not many bridge carpenters like to handle treated wood; it is black, sometimes dirty, and is not nearly so nice to handle as untreated wood. One of our greatest difficulties has been to try to make the handling of treated wood as pleasant as possible.

Wood will always be used in unimportant overhead highway bridges. The problem of renewing a large number of these bridges with concrete or steel structures is beyond the financial ability of most of our roads today, and from the standpoint of economy there is no reason why a timber bridge cannot serve the purpose just as well. The only thing to be done is to see that the timber is treated and installed properly. Many bridge men feel that they can handle treated wood the same as they used to be able to handle untreated wood; that is, to have a miscellaneous bill of material shipped to the bridge and from that bill of material erect a structure. With the use of treated wood your methods must change if you are to get the proper results.

Now, in order to convince you that I am not talking from a theoretical standpoint but from actual practice, I desire to state that the two roads with which I am connected are building a great many structures of this character, framing them in every particular, then treating them and shipping them to the bridge site and erecting them. The framing of such a bridge can be done cheaper by machinery at a treating plant than it ever can be done on the job while the time of erection is greatly decreased. Also, the bridge carpenters themselves are relieved of a great deal of what they used to call the dirty work in connection with creosoted wood, if that material is framed before it is shipped, because their work becomes purely assembling.

There are unimportant overhead highway crossings used by only a few teams a day which must still be maintained. A creosoted structure requires no painting or general repairs for 25 years if the treatment is properly done.

Some bridge men are prone, at times, to feel that it is impossible to frame bridge timbers before treatment, but I want to cite a few examples of what we have actually done. The bridges to which I will refer have been provided with decks that were framed and treated before being shipped to the job. We have a bridge at West Milton, Pa., which was built about six years ago, in which every bridge tie and guard rail was framed according to a definite design before it was shipped to the job.

The L. & N. has a bridge across the Ohio river at Evansville, Ind., which was built in 1888. It is one of the finest examples of treated wood in the country. Due to the increasing traffic the L. & N. has had to strengthen that bridge and it found that not over 25 per cent of the piles needed repair because of decay. Those piles were octagonal and everyone was covered by the cap. Too many piles have been put in trestles with too large butt measurements, and you know what it means to chamfer off the ends so as to make a good looking job. That chamfering is the point where decay and moisture enter into the butts of the piles and cause rot. A great deal of the success of this L. & N. bridge is due to the fact that those piles were sized to fit the caps. Many roads using 12-in. caps are not covering the butts of their piles. By chamfering these piles to fit the caps, you overcome much of the beneficial effects of the creosoting. It would probably be far better if the tops of the piles were cut off square and left in that manner. You may say that this creates a fire risk; this, I am not prepared to discuss. It would probably be better to use a larger cap.

We did not build our own treating plant until 1912. In a recent bridge inspection it developed that one of our bridge foremen ordered some bridge ties for use in 1911. It had been the habit on our road to order 24 ft. timbers, even when he wanted the 12 ft. sticks. Those 9 in. by 12 in. by 24 ft. timbers were creosoted as 24 ft. timbers and sent to him. He then turned around and cut them in half. The result is self evident. The nearer you can have your timber treated to the size you are going to use it, the better job you will get.

A new problem has recently developed up the Bay from San

Francisco proper in a territory where the engineers thought that they were entirely immune from pile boring animals. Due to the lessened rainfall in the Sacramento river, salt water was able to creep up farther than it ever had before with the result that teredo got into the structures which had previously been considered immune from such action, with the result that the total damage to date in San Francisco harbor has amounted to about $25,000,000, in replacing structures that were suddenly attacked and fell into the waters. The Southern Pacific was probably hit the hardest, although Mare Island Navy Yard had big losses, as did everybody who had big pile structures in the eastern part of San Francisco bay.

There is now under construction a new pier development at Stapleton on Staten Island in New York harbor. There is no reason why New York harbor should not experience the same difficulties as San Francisco at some time in the near future. We in New York think that the teredo, limnoria and xylotrya are not going to be able to get to our piles because we suppose there is enough sewage and acid water and that the water is cold enough to keep them out. It was just that same faith in something that had never happened in the upper part of San Francisco bay that allowed these people to keep on building structures from untreated piling. To any one who has studied the San Francisco bay work, the conclusion comes that there is just such a possibility in New York bay.

The pier development in New York harbor is on the east side of Staten Island, very close to the Narrows. This would be the first point where the teredo and limnoria would start as it is near salt water. There are 80,000 piles in that pier and possibly $20,000,000 invested. The engineers have been careful with the roof structures; they have put in all the labor-saving devices for loading boats. They have worked out the details of their floor design very carefully and yet underneath they have used untreated piles which, if the right conditions were to exist for two months, might be eaten off in three or four weeks, so that those piers would collapse.

We have a bridge across New York bay from Bayonne to Elizabethtown that was built in the 80's and was completely riddled by teredo. Those animals have a way of coming back once in a while. They may not be like the 17-year locusts, but when the conditions are favorable and they increase as quickly as they do,

we are not at all certain of our structures unless more pains are taken in the treatment of piling.

Pier 19 of the Central Railroad of New Jersey coal dumper pier has about 6,000 piles in it. Every one of them is treated to the fullest possible extent with creosote and on top of that are put a concrete deck and superstructure. There seems to be a divergence of opinion among engineers in this country as to whether they should use creosoted piles for protection against marine borers. Some engineers feel that the borers have been here once, and feel that they can come back again. Mr. Owen of the Jersey Central is very strongly of that opinion.

I feel that it is possible, where conditions are right, for the wood structures in New York bay to be affected possibly as far north as the Harlem river. We have found on the Pacific Coast that in any stream that is subject to tidal action salt water, being heavier, may creep up stream much farther than the surface water would indicate. In other words, if you take samples from the surface of streams you will not get the conditions at the bottom. If any of you have streams that might be affected by marine borers, the best test is to find out whether there is any salt water present. If so, there is no telling when you may have an occurrence of marine borers.

We put in some jetties near Atlantic Highlands about six years ago to protect the railroad track between Atlantic Highlands and Seabright. We thought that we could use untreated planking in connection with those jetties, figuring that the sand would cover them up before the marine borers would get in. By the time the contractor got the outer end of 400 ft. jetties finished, which was about two months, with slow driving, the inner end was entirely riddled. In other words, we have a condition as close to New York as Atlantic Highlands where a structure has been entirely ruined in two months.

DISCUSSION

N. H. LaFountain:—I would like to ask if there are any records of borers having worked in piling that has been treated.

Mr. Taylor:—Yes, there are. The creosoting industry is like many others. Good work can be secured for a good price, while there are times when a poor price is paid and a poor job is done. Marine borers are always looking out for these poor jobs, and as a result we have records where teredo have gotten into creosoted

piles. You men who drive piles handle creosoted piles so roughly that by the time they are assembled into a bridge this rough handling has unearthed untreated areas, which are undoubtedly subject to the attacks of marine borers. One other difficulty is the fact that we usually have to treat the piling green. Specifications requiring 10 or 12 lb. treatment are usually used but one cannot get as good treatment as he should under these conditions. The American Railway Engineering Association is, I think, going to demand 16 lb. treatment for this purpose this year and will probably go to 24 lb. for marine work. If that is done you will get a good job in marine piling very soon.

H. C. Keith:—I would like to ask the speaker if teredo have gotten in where the creosoting has leached out in timber that has been soaked in water.

Mr. Taylor:—There have been cases where the toxic qualities have leached out and teredo have been found. It takes good creosoting to prevent this.

R. H. Reid:—We have framed the timber complete for several bridges before erection, even to the boring of the bolt holes for bracing, and the framing and boring of the stringers. Most of these bridges have been highway bridges. The treatment has not seemed to warp the timber much, and when the bridges were assembled they went together with practically no trouble at all, and make an excellent job.

Mr. Taylor:—Mr. Knowles has been one of the most ardent advocates we have had of treated water tanks. He is an example of an experienced railway man coöperating with the timber treating experts to develop a practice that is of great service to his road. There is room for much more coöperation between the treating man and the bridge and building man. I believe that the lack of coöperation in the past is largely the fault of the timber treating man. He usually does not have close contact with experienced bridge builders and is sometimes liable to be a little narrow in discussing the bridge building problem with the field man.

C. R. Knowles:—With us the creosoted tank was largely a question of necessity. We could not get untreated timber of proper quality so we had to resort to something else. As a result we have been putting up creosoted tanks since 1916 until we now have 32 such tanks in service and are building three more at the present time, while I think we have material for 9 or 10 more tanks on hand in the yards. Our tanks are framed completely

before being treated. The entire tank, including staves, bottom plank, braces, posts, frost box and roof, is creosoted, and with the exception of the 1-in. drop siding and sheeting for the roof it is all framed before treatment.

N. H. LaFountain:—I would like to ask if you have any record of the cost of creosoting the tanks proper and the framing.

C. R. Knowles:—I am sorry I have no definite figures. We treated some timbers with 10c oil and some with oil as high as 26c. We treated some by the Rueping process and some by the full-cell process. The cost varied but in every case was less than long-lived untreated timber. I would say that the average cost is less than $100 per thousand while we would probably have to pay $175 to $225 for first-class cypress and $150 to $175 per thousand for redwood.

President Strouse:—I should like to ask Mr. Knowles what kind of timber is used in the treated tanks.

C. R. Knowles:—We use loblolly pine and long leaf pine. We try to use all sap loblolly pine as much as possible, although it is impossible to get all sap timber. The sap timber takes the treatment better.

Secretary Lichty:—Another reason, I presume, is that it is cheaper.

President Strouse:—Does the long leaf yellow pine take treatment unless it has sapwood on it?

C. R. Knowles:—Yes, we get sufficient penetration in heart pine to protect the timber. We get almost complete penetration of the 3-in. staves.

N. H. LaFountain:—Have you arrived at its life?

C. R. Knowles:—We can only estimate the life of the timber but we believe it will be at least 30 years.

N. H. LaFountain:—Is it not a fact that heart pine or redwood would last that long without treatment if well taken care of?

C. R. Knowles:—There are records of redwood tanks in service as long as 40 years, and similar records of cypress tanks in service 34 years. In the proceedings of this association in 1915 you will find a record of some 400 or 500 tanks. The average life of those cypress tanks was, if I remember correctly, 29 years, and 34 years for a number of redwood tanks on the Southern Pacific. The redwood tanks were a selected list of tanks on one road, while the cypress tanks were on a number of different railroads, chiefly in the south.

Tanks constructed of long-leaf yellow pine, with few exceptions, are relatively short-lived. I believe Mr. McVay showed a record on the L. & N. of one long-leaf yellow pine tank in service some 30 years.

Secretary Lichty:—Is it not quite likely that was selected material which would cost more than creosoted material does now?

C. R. Knowles:—Yes, beyond a doubt; we cannot get that quality of material now. For example, Mr. McVay showed the life of a yellow poplar tank was something like 30 years. He also showed the record of a red cedar tank in service some 50 years. To secure such timber now is quite out of the question, nor can we get good quality cypress at all times. One can get heart red cypress once in a while, but he cannot start building cypress tanks and be assured of getting first-class heart red cypress at all times. You can get redwood, but there is some question whether the redwood will have the same life in this country that it has in the locality where it is grown. Mr. Ward could possibly tell us more about the possibility of getting first-class timber, if I may be allowed to call on him. I know we have had extreme difficulty in getting select tank lumber at all times.

C. E. Ward:—Mr. Knowles was correct when he said it was not possible to get tank materials exactly as they should be since the war began. Now that war conditions are over, there is no question but that one can get as good cypress as he did previously. Our stock is complete and the longer lengths are now available while the prices quoted are real pre-war prices. There has been a very marked reduction in the prices of both redwood and cypress, cypress dropping even more than the redwood; so that the two lumbers now compare favorably with pre war bases. I do not think anyone need have any apprehension regarding the quality of cypress tanks or redwood tanks. Personally, I would not give much more for a cypress tank than I would for redwood. I think the life is about the same.

J. S. Robinson:—We have had white pine tanks in use from 30 to 31 years. The staves were of 4-in. clear white pine. When we took them down in 1902 we found that 30 per cent of the staves were poor, and we replaced them with new staves. Last year we replaced one of those tanks and found 25 or 30 per cent of the staves still good. We are now taking down white pine tanks with 4-in. staves, cutting off the ends and using them again.

C. R. Knowles:—No doubt Mr. Robinson is correct in regard

to the use of white pine, but unfortunately, one cannot get white pine of the proper quality and dimensions for the construction of railroad tanks now. As far as white pine and cypress are concerned, I think one is as good as the other. That has been borne out in my experience by tanks on our line, as well as the records furnished by other railroads. I have always favored cypress as a tank material. In my opinion it is one of the best timbers available for tanks. By that I mean heart red cypress. I believe that it is good for 50 years, provided it is given proper care. There is one difficulty in getting a record of long life of cypress tanks, and that is the fact that, as Mr. Robinson says, up to 25 or 30 years ago, white pine was used almost exclusively for tanks and the use of cypress only began after the white pine began to get scarce. As a result, we naturally have longer records of life with white pine tanks than with cypress tanks though the white pine tanks in use are not as numerous as the cypress tanks, by any means.

J. S. Robinson:—Does not that depend somewhat on the railroad? If it extends into a cypress country, it would use cypress, while if it invaded a white pine country, the road would use white pine.

C. R. Knowles:—That is true in recent years, but up to about 15 or 20 years ago, we used white pine tanks in Louisiana and Mississippi. We have white pine tanks in that territory which are located in cypress sloughs with cypress saw mills in the immediate vicinity.

S. R. Church:—I know that there are men here tonight who are not as much interested in New York City's problems perhaps as I am. I live here, and I know from personal experience that the marine borers are in certain piling in these waters because I belong to a yacht club here and we have had a pier fail. I have examined those piles at the ground line and have seen where they were destroyed by the borers, and if it had not been for the fact that the building on top of the dock was comparatively light, it would have fallen, a good many years ago as they did in San Francisco.

I think Mr. Taylor has given New York a real vital message, and I hope it will get across. It is interesting to know that Coney Island is going to build a 2½-mile walk that is going to be of creosoted timbers. Does that indicate that the engineers have suddenly seen the light, or as the quotation goes, "shall a city in doing things not let the left hand know what the right hand doeth?" At any rate, I hope before more important docks are built that

the engineers who are building that board walk will have an opportunity to demonstrate the value of treated timber.

E. G. Storck:—As Mr. Taylor said we use creosoted timber on all our bridges, and if it is possible we have it framed before we creosote it. I notice in some of the ties that have been cut off, that decay is present in some of our bridges. I was interested to hear of creosote being used on water tanks. We have used yellow pine and red cedar tanks, but the red cedar is getting scarce of late, so we have been using yellow pine. I would like to ask about the seepage between the staves in the creosoted tanks. How does that compare with untreated staves?

C. R. Knowles:—You have to use proper care in erecting creosoted tanks. You can't depend upon the water swelling the staves, and making good poor workmanship. We have, as I say, put quite a few of those tanks up and I think some five or six of them leaked rather badly, but the great majority of them were absolutely tight from the time of completion. The edges of our staves are sawed, that is, where one stave joins another, instead of being planed. That permits of tighter joints. There is just one point to remember in connection with tanks—get sufficient staves in the tank. Pay no attention to the staves at the top, but get enough at the bottom.

F. M. Case:—I would like to ask Mr. Knowles whether he knows if those extremely old tanks of which he spoke have been kept well painted.

C. R. Knowles:—I think painting cypress is like painting the lily. It doesn't make any difference one way or the other. I have two tanks in Clayton, Miss., that were erected in 1884. These happen to be cypress tanks. I know they haven't been painted for 20 years, and I doubt if they were ever painted after erection. I don't think paint would make any difference. In fact, there may be something in the theory that an unpainted tank will last longer than a painted tank due to the fact that you get a better penetration of moisture. I know that is true of wood used in pipe lines. The records of the wood used in pipe lines show that the thicker pipe lines have deteriorated more rapidly than those built of thinner material. Of course, in using a wood pipe line, it was thought necessary to make the staves very thick to withstand the pressure, but they found they could strengthen the pipe by heavier bands

... in the material by decreasing the thickness ... would penetrate the stave and help preserve it. ... Paint, I think, is a very good thing on most struc... a water tank is good only for appearance.

... There is an old tank on the Rio Grande sys... Ogden and Salt Lake that has been erected for some... years. It has never been painted, but the water ... go up there every year and tear down all the trees ... around the tank. It stands up as well as any of the ... that we paint regularly once a year.

... H. Reid:—As I stated some time ago, we have used creo... in several frame bridges, but we have not used creo... to any extent, and I wanted to ask if any one is fa... with the leaching of the creosote, or whether it can be de... upon indefinitely. Can the protection of creosote be de... upon indefinitely in water? Also is there much additional ... from fire in creosoted piles driven under ordinary condi... where there is grass and rubbish?

A. B. Ilsley:—The L. & N. has, I think, had the longest experi... with creosoted timber. They have piles that have been in ... water for something like 30 years, which answers the question ... leaching. If they don't leach in that length of time they don't ... very fast.

R. H. Reid:—Are they still pretty well saturated with the creosote?

A. B. Ilsley:—I understand they are.

J. J. Taylor:—Those of you who read the Railway Review remember a very good account of the experience which they had with a fire on a creosoted trestle where the piling went through in fine shape. That, I think, is a good example of what one can expect with creosoted piling. We have tried it out and it stood the test.

Note: This Association received the title—American Railway Bridge and Building Association—at the 18th annual convention at Washington, D. C., October, 1908. Prior to that time it was called —Association of Railway Superintendents of Bridges and Buildings.

LIST OF ANNUAL CONVENTIONS.

No.	Place.	Date.	Membership.
1	St. Louis, Mo.,	Sept. 25, 1891	60
2	Cincinnati, Ohio,	Oct. 18-19, 1892	112
3	Philadelphia, Pa.,	Oct. 17-19, 1893	128
4	Kansas City, Mo.,	Oct. 16-18, 1894	115
5	New Orleans, La.,	Oct. 15-16, 1895	122
6	Chicago, Ill.,	Oct. 20-22, 1896	140
7	Denver, Colo.,	Oct. 19-21, 1897	127
8	Richmond, Va.,	Oct. 18-19, 1898	148
9	Detroit, Mich.,	Oct. 17-18, 1899	148
10	St. Louis, Mo.,	Oct. 16-18, 1900	143
11	Atlanta, Ga.,	Oct. 15-17, 1901	171
12	Minneapolis, Minn.,	Oct. 21-23, 1902	195
13	Quebec, Canada,	Oct. 20-22, 1903	223
14	Chicago, Ill.,	Oct. 18-20, 1904	293
15	Pittsburg, Pa.,	Oct. 17-19, 1905	313
16	Boston, Mass.,	Oct. 16-18, 1906	340
17	Milwaukee, Wis.,	Oct. 15-17, 1907	341
18	Washington, D. C.,	Oct. 20-22, 1908	368
19	Jacksonville, Fla.,	Oct. 19-21, 1909	393
20	Denver, Colo.,	Oct. 18-20, 1910	428
21	St. Louis, Mo.,	Oct. 17-19, 1911	499
22	Baltimore, Md.,	Oct. 15-17, 1912	524
23	Montreal, Que.,	Oct. 21-23, 1913	570
24	Los Angeles, Cal.,	Oct. 20-22, 1914	586
25	Detroit, Mich.,	Oct. 19-21, 1915	665
26	New Orleans, La.,	Oct. 17-19, 1916	710
27	Chicago, Ill.,	Oct. 16-18, 1917	704
28	Chicago, Ill.,	Oct. 15-17, 1918	716
29	Cleveland, O.,	Oct. 21-23, 1919	776
30	Atlanta, Ga.,	Oct. 26-28, 1920	840
31	New York, N. Y.,	Oct. 18-20, 1921	850

	1891-2.	1892-3.	1893-4.	1894-5.
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews.
1st. V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle.
2nd. V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford.
3rd. V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard.
4th. V.-Pres.	G. W. Hinman	C. E. Fuller	E. D. Hines	Walter G. Berg.
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid.
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard.
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis.
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin.
	G. W. McGehee	Q. McNab	James Stannard	R. M. Peck.
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White.
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane.

	1895-6.	1896-7.	1897-8.	1898-9.
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. H. Cummin.
1st. V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley.
2nd. V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard.
3rd. V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers.
4th. V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes.
	J. L. White	W. M. Noon	C. P. Austin	J. H. Markley.
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston.
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin.
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner.
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman.

	1899-1900.	1900-1901.	1901-1902.	1902-1903.
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering.
1st. V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard.
2nd. V.-Pres.	J. M. Staten	B. F. Pickering	A. Shane	A. Shane.
3rd. V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman.
4th. V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith.
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick.
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin.
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty.
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston.
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley.

	1903-1904.	1904-1905.	1905-1906.	1906-1907.
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley.
1st. V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid.
2nd. V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty.
3rd. V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse.
4th. V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin.
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam.
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond.
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey.
	H. Rettinghouse	W. H. Finley	H. H. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt.

	1907-1908.	1908-1909.	1909-1910.	1910-1911.
President	R. H. Reid	J. P. Canty	J. S. Lemond	H. Rettinghouse
1st. V.-Pres.	J. P. Canty	H. Rettinghouse	H. Rettinghouse.	F. E. Schall
2nd. V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd. V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th. V.-Pres.	W. O. Eggleston.	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston.
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912.	1912-1913.	1913-1914.	1914-1915.
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st. V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd. V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd. V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th. V.-Pres.	T. J. Fullem	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Cantv	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	W. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st. V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920		1920-1921	1921-1922
President	F. E. Weise	President	W. F. Strouse	C. R. Knowles
1st. V.-Pres.	W. F. Strouse	1st. V.-Pres.	C. R. Knowles	A. Ridgway
2nd V.-Pres.	C. R. Knowles	2nd V.-Pres.	A. Ridgway	J. S. Robinson
3rd V.-Pres.	A. Ridgway	3rd V.-Pres.	J. S. Robinson	J. P. Wood
4th V.-Pres.	J. S. Robinson	4th V.-Pres.	J. P. Wood	C. W. Wright
Sec.-Treas.	C. A. Lichty	Sec.-Treas.	C. A. Lichty	C. A. Lichty
Executive Members	J. P. Wood	Directors	C. W. Wright	E. T. Howson
	A. B. McVay		A. B. McVay	J. H. Johnston
	J. H. Johnston		G. A. Manthey	E. K. Barrett
	E. T. Howson		E. T. Howson	F. C. Baluss
	C. W. Wright		J. H. Johnston	Maro Johnson
	G. A. Manthey		E. K. Barrett	O. F. Dalstrom

CONSTITUTION*

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1. The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussions unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1. The membership of this association shall consist of two classes—active and life members.

Section 2. To be eligible for active membership, a person must be in responsible charge of the design, construction or maintenance of railway bridges, buildings or other structures directly, in a consulting capacity, or in the employ of a public regulatory body; a professor of engineering in a college or university of recognized standing; an engineering editor or a government or private timber expert. All applications for membership shall be referred to the membership committee, consisting of three members of the executive committee, one of whom shall be a past president, and these applications shall be approved by this committee before submission to the association for election.

Section 3. To be eligible for life membership, a member must have been a member of the association for at least five years and in general must have retired from active railway service, although the association may waive the latter condition by a majority vote of the members at a regular session for good and sufficient reasons. Life members shall be elected on the recommendation of the executive committee, which committee shall report its recommendations to the association annually. A life member shall have all the privileges of active membership and shall not be required to pay annual dues.

*Revised 1920.

Section 4. Any member guilty of conduct unbecoming a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, may forfeit his membership on a two-thirds vote of the executive committee.

Section 5. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

ARTICLE IV.

OFFICERS

Section 1. The officers of this association shall be a president, four vice-presidents, a secretary-treasurer and six directors who with the most recent past president shall constitute the executive committee.

Section 2. The past presidents of this association, other than the most recent past president, who continue to be members, shall be privileged to attend all meetings of the executive committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, nor shall their presence be requisite in order to constitute a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1. The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association but shall not have the power to render the association liable for any debt beyond the amount then in the treasury and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any active member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for reëlection.

Section 2. The president, four vice-presidents and secretary-treasurer shall hold office for one year and the directors for two years, three being elected each year. All officers retain their offices until their successors are elected and installed.

Section 3. The term of office of the secretary-treasurer may be terminated at any time by a two-thirds vote of the executive committee. His compensation shall be fixed by a majority vote of the executive committee. The secretary-treasurer shall also serve as secretary of the executive committee.

Section 4. The secretary-treasurer shall be required to give bond in an amount to be fixed by the executive committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1. Every member upon joining this association shall pay to the secretary-treasurer an entrance fee of $3 and annual dues for one year. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the executive committee.

ARTICLE VIII.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

BY-LAWS*

TIME OF MEETING

1. The regular meeting of this association shall convene annually on the third Tuesday in October at 10 a. m.

PLACE OF MEETING

2. The place of holding the next annual convention shall be selected by ballot at the annual meeting of the association. All the places proposed shall be submitted to a ballot vote of the members present at the annual business session and the place receiving a majority of all votes cast shall be declared the location of the next annual meeting. If no place receives a majority of the votes cast, the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

3. It shall lie within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

*Revised 1920.

DUES

5. The annual dues are $4 per year, payable in advance.

DUTIES OF OFFICERS

6. The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall, with the secretary-treasurer, sign all contracts or other written obligations of the association which have been approved by the executive committee. At the annual meeting the president shall present a report containing a statement of the general condition of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8. It shall be the duty of the secretary-treasurer to keep a correct record of the proceedings of all meetings of this association, and of all accounts between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall invest all funds not needed for current disbursements as shall be ordered by the executive committee. He shall pay all bills, when properly certified and approved by the president, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

NOMINATING COMMITTEE

9. After each annual meeting the president shall appoint a committee of five members, not officers of the association, of whom two at least shall be past presidents, and two of whom shall have served on the committee the previous year, which shall prepare a list of names of nominees for officers to be voted on at the next annual convention, in accordance with Article VI of the constitution, said list to be read at the first session of the second day of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

10. Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary-treasurer and certify as to the correctness of his accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

11. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

12. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

13. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

ORDER OF BUSINESS

14. Call to order by president.
Opening prayer or invocation.
President's address.
Reading minutes of last meeting.
Report of secretary-treasurer.
Report of membership committee.
Admission of new members.
Recess to permit registration of members and payment of annual dues.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Selection of place for next annual meeting.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

15. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise all discussions shall be governed by Robert's rules of order.

DIRECTORY OF MEMBERS

Aagaard, P., Pres. T. S. Leake Const. Co., Transp'n. Bldg., Chicago.
Ailes, N. C., Engr. of Records, D. & H. Co., Albany, N. Y.
Airmet, E. S., For. Ptr., O. S. L. R. R., Salt Lake City.
Airmet, J. S., Ptr. For., O. S. L. R. R., Nampa, Idaho.
Alexander, S. Y., G. F. B. & B., St. L. B. & M. Ry., Kingsville, Tex.
Alexander, L. B., Asst. Br., Engr., M. C., Detroit, Mich.
Allard, E. E., For. B. & B., Mo. Pac. Ry., St. Louis.
Althof, L. W.
Anderson, August, Gen'l For. B. & B., L. S. & I. Ry., Marquette, Mich.
Anderson, L. J., Supv. B. & B., C. & N. W. Ry., Escanaba, Mich.
Andrews, G. W., Asst., M. of W. Dept., B. & O. R. R., Baltimore, Md.
Andrews, T. O., L. E. & W. R. R., Tipton, Ind.
Archbold, H. L., Asst. Engr., Sou. Pac. Co., Portland, Ore.
Arey, R. J., 541 So. Cummings St., Los Angeles, Calif.
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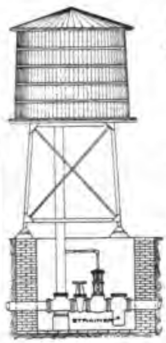
No Floats or Fixtures. No Freezing. No Valves inside of Tanks. Automatically maintain a uniform stage of water in Standpipes, Reservoirs or Tanks. No overflow in case of fire pressure. Valves closed by water or electricity.

ADJUSTMENT FOR HIGH & LOW PRESSURE

Valves Air and Water Cushioned—no metal to metal seats. Virtually Indestructible. Cheapest in the end.



Automatic Valves

For Steam and Water Service

FLOAT VALVES
STANDPIPE VALVES
ELECTRO-HYDRAULIC VALVES

Valves to 24 inch

The Golden - Anderson Automatic Float Valves

are instantly adjusted to operate quickly or slowly as desired. Indestructible. They are *absolutely the only satisfactory Float Valve known for high or low pressure*

Valves up to 24 inches

Water Pressure Regulating
Valves to 24 inch

Automatic Cushioned Water Pressure Regulating Valves

We make the largest, heaviest and most correct mechanically constructed and operated line of Automatic Valves for high or low pressure steam and water service in the U. S.

Golden - Anderson Valve Specialty Co.

1207 Fulton Bldg. Pittsburgh, Pa.

An Idea Worth While

Several of the Trunk Lines are abandoning the use of spigots in Country, Line Stations and Depots, for the combination Fig. 100 to avoid freeze-ups and theft of spigots. Others are using them at sinks in freight houses for wetting bill-of-lading cloths. Others in small shop washhouses.

One of the big Southwest Roads have everyone of their laborers' (Mexican) shanties fitted up with this combination. As Harry Lauder says "you canna' beat it."

Make requisition read, Volkhardt Station Cocks, Fig. 100, of the size you require. Order some at once before you forget it.

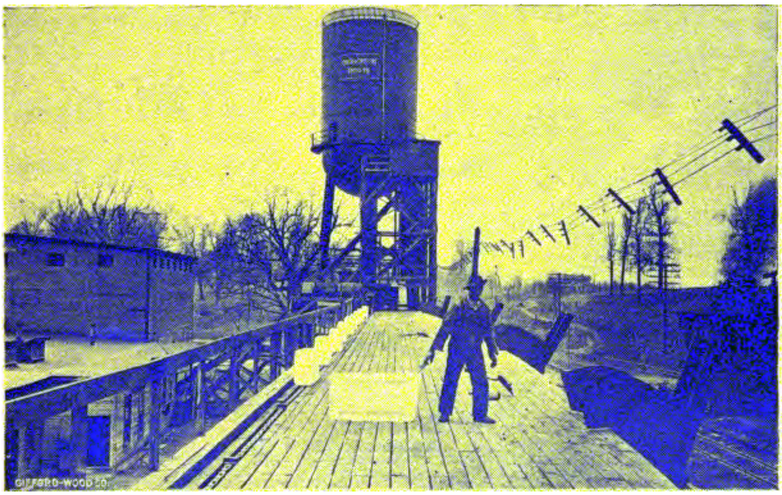
See Feb. 1920 Bulletin, Page 6

VOLKHARDT COMPANY, Inc.

Home Office: 83 Prospect Street, Stapleton, Sta. S. I.
New York City

Western Office: 537 S. Dearborn St., Chicago, Ill.

Icing Station Machinery



G-W Car Icing Equipments

are in use by all leading Packers and Railroads

Some of the Users Include

N. Y. C. & H. R. R.
Union Pacific
C. M. & St. P.
I. I. & I.
C. & N. W.
Erie
D. L. & W.
B. & O.
So. Pacific
D. & H.
L. V.

C. N. E.
Nat'l Pkg. Co.
Armour & Co.
Swift Co.
Morris & Co.
Cudahy & Co.
Mexican Nat'l Pkg. Co.
Hammond & Co.
Pacific Fruit Express
Fruit Growers Express
Chi. Ind. & So.

Santa Fe
O. S. Line
B. & A.
C. R. I. & P.
Cen. of N. J.
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Ill. Central
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We Design, Manufacture and Install Ready for Use

Ice Elevators, Conveyors, Lowering Machines, Platform Conveyors, Salt Elevators Ice Crushers, Crushed Ice Elevators and Carts

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Including

Planers, Scrapers, Plows, Markers, Bars, Chisels Hooks, Tongs, Shavers, Saws, Etc.

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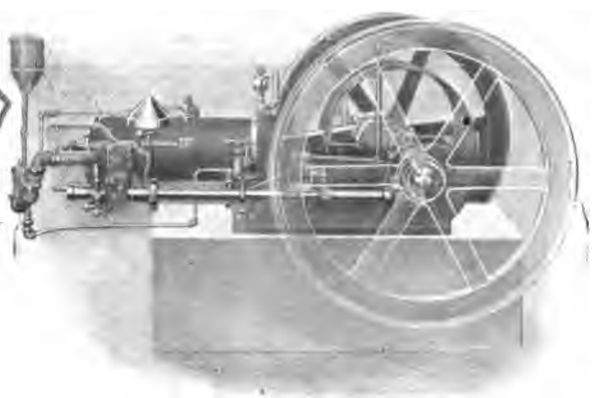

245 Ft. Double Track Bascule Bridge, Built for the Michigan Central R. R., at Detroit, Mich.